

1  
00:00:03,500 --> 00:00:05,700  
NARRATOR: YOU'VE JUST TAKEN OFF.

2  
00:00:07,733 --> 00:00:09,533  
MAYBE YOU'RE GOING  
TO SEE FAMILY

3  
00:00:09,633 --> 00:00:12,266  
OR HEADING OFF  
ON A BUSINESS TRIP.

4  
00:00:12,366 --> 00:00:14,766  
BUT THE GROUND'S NOW  
FAR BENEATH YOU,

5  
00:00:14,866 --> 00:00:18,266  
AND YOU'VE GOT THOUSANDS  
OF MILES AHEAD.

6  
00:00:18,366 --> 00:00:21,033  
YOU'RE AIRBORNE.

7  
00:00:21,133 --> 00:00:23,066  
TO US PASSENGERS, THIS IS

8  
00:00:23,166 --> 00:00:26,100  
THE MOST UNEVENTFUL  
PART OF ANY FLIGHT.

9  
00:00:26,200 --> 00:00:28,900  
BUT BEHIND THE SCENES,  
THERE'S A HIDDEN ARMY

10  
00:00:29,000 --> 00:00:31,933  
KEEPING YOU UP IN THE AIR...

11  
00:00:32,033 --> 00:00:34,900  
BECAUSE TO GET YOU SAFELY  
TO YOUR DESTINATION,

12  
00:00:35,000 --> 00:00:39,566  
YOU NEED FAR MORE THAN  
JUST A BOARDING PASS.

13  
00:00:39,666 --> 00:00:43,000  
IT TAKES AIR TRAFFIC CONTROLLERS  
TO CLEAR YOUR ROUTE

14  
00:00:43,100 --> 00:00:45,200  
THROUGH THE SKY,

15  
00:00:45,300 --> 00:00:48,133  
DOCTORS TO KEEP YOU  
SAFE IN FLIGHT...

16  
00:00:48,233 --> 00:00:49,833  
SO HE IS HAVING  
TROUBLE BREATHING,

17  
00:00:49,933 --> 00:00:52,500  
AND THE REPEAT PULSE  
IS 240.

18  
00:00:52,600 --> 00:00:55,100  
IS THAT CORRECT? OVER.

19  
00:00:55,200 --> 00:00:56,366  
NARRATOR: CARGO HANDLERS

20  
00:00:56,466 --> 00:00:59,466  
TO COPE WITH EVERY IMAGINABLE  
TYPE OF AIR FREIGHT...

21  
00:00:59,566 --> 00:01:01,333  
[NEIGH]

22  
00:01:01,433 --> 00:01:02,333  
[THUNDER]

23  
00:01:02,433 --> 00:01:04,800  
NARRATOR: EXPERTS TO  
PROTECT YOUR PLANE.

24  
00:01:04,900 --> 00:01:05,833  
SCHUSS.

25  
00:01:05,933 --> 00:01:07,166  
[ELECTRICAL BUZZING]

26  
00:01:07,266 --> 00:01:11,300  
AND ALL THIS IS HAPPENING  
WHILE YOU'RE AT 30,000 FEET.

27

00:01:12,800 --> 00:01:15,933  
THIS IS THE CITY IN THE SKY,

28  
00:01:16,033 --> 00:01:19,666  
A CITY WHOSE POPULATION CONSISTS  
OF THE ONE MILLION PEOPLE

29  
00:01:19,766 --> 00:01:24,966  
AIRBORNE AT ANY TIME  
AND WHO ARE UP THERE RIGHT NOW,

30  
00:01:25,066 --> 00:01:26,766  
A FLYING CITY THAT STRADDLES

31  
00:01:26,866 --> 00:01:30,866  
NOT JUST COUNTRIES,  
BUT CONTINENTS.

32  
00:01:30,966 --> 00:01:33,333  
IT'S BUILT OUT OF  
THE 100,000 FLIGHTS

33  
00:01:33,433 --> 00:01:38,300  
THAT CRISS-CROSS THE PLANET  
EVERY SINGLE DAY.

34  
00:01:38,400 --> 00:01:42,266  
THIS CITY IS AN INCREDIBLE  
FEAT OF ENGINEERING,

35  
00:01:42,366 --> 00:01:46,700  
DEPENDENT UPON ADVANCED  
TECHNOLOGY AND GLOBAL NETWORKS,

36  
00:01:46,800 --> 00:01:51,633  
A HIDDEN WORLD RARELY GLIMPSED  
BY OUTSIDERS...

37  
00:01:51,733 --> 00:01:54,166  
UNTIL NOW.

38  
00:02:04,366 --> 00:02:05,766  
WELCOME ABOARD.

39  
00:02:09,033 --> 00:02:11,666  
NARRATOR: WE'VE BECOME SO USED  
TO JETTING AROUND THE GLOBE,

40

00:02:11,766 --> 00:02:15,033  
WE TAKE FLIGHT COMPLETELY  
FOR GRANTED.

41

00:02:15,133 --> 00:02:20,166  
WITHOUT THE SLIGHTEST THOUGHT,  
YOU FIND YOURSELF IN THE SKY.

42

00:02:20,266 --> 00:02:23,933  
YOU GET SETTLED FOR  
THE LONG FLIGHT AHEAD.

43

00:02:24,033 --> 00:02:27,000  
THE HOURS ROLL ON BY,

44

00:02:27,100 --> 00:02:30,333  
PUNCTUATED BY WELCOME  
DISTRACTIONS.

45

00:02:30,433 --> 00:02:32,433  
YOU MIGHT WATCH  
AN IN-FLIGHT MOVIE

46

00:02:32,533 --> 00:02:34,700  
OR TRY TO GET SOME SLEEP

47

00:02:34,800 --> 00:02:39,000  
AND HOPE THAT WHEN YOU WAKE UP,  
YOU'LL BE AT YOUR DESTINATION.

48

00:02:40,833 --> 00:02:43,933  
BUT HAVE YOU EVER CONSIDERED WHAT A MIRACLE IT IS

49

00:02:44,033 --> 00:02:46,333  
THAT WHILE YOU'RE  
ENJOYING THAT NAP,

50

00:02:46,433 --> 00:02:49,800  
YOU'RE CRUISING ALONG  
AT 30,000 FEET?

51

00:02:54,733 --> 00:02:57,633  
STAYING AIRBORNE  
IS ONE OF THE GREAT  
ACHIEVEMENTS

52

00:02:57,733 --> 00:03:00,833

OF MODERN  
ENGINEERING,

53  
00:03:00,933 --> 00:03:03,066  
AND IT ALL RELIES UPON A HANDFUL

54  
00:03:03,166 --> 00:03:05,800  
OF FUNDAMENTAL LAWS  
OF PHYSICS...

55  
00:03:08,166 --> 00:03:10,700  
WHETHER YOU'RE A PASSENGER JET

56  
00:03:10,800 --> 00:03:13,433  
OR SOMETHING MUCH SMALLER.

57  
00:03:16,866 --> 00:03:19,300  
THESE MAY LOOK LIKE  
ORDINARY MEN,

58  
00:03:19,400 --> 00:03:21,800  
BUT THEY'RE MORE THAN JUST THAT.

59  
00:03:21,900 --> 00:03:27,266  
THEY'RE AIRCRAFT WITH WINGS  
LESS THAN 7 FEET ACROSS.

60  
00:03:27,366 --> 00:03:30,666  
THEIR BODIES ACT LIKE  
AN AIRCRAFT'S FUSELAGE,

61  
00:03:30,766 --> 00:03:33,233  
AND JUST LIKE A LARGE  
PASSENGER PLANE,

62  
00:03:33,333 --> 00:03:37,300  
THEY'RE POWERED  
BY 4 JET ENGINES.

63  
00:03:37,400 --> 00:03:41,166  
THEY CALL THEMSELVES  
THE JET-MEN,

64  
00:03:41,266 --> 00:03:43,733  
AND THE PRINCIPLES THEY USE  
TO STAY IN FLIGHT

65

00:03:43,833 --> 00:03:44,833  
ARE EXACTLY THE SAME

66  
00:03:44,933 --> 00:03:48,000  
AS THOSE THAT KEEP  
US PASSENGERS UP THERE.

67  
00:03:50,933 --> 00:03:54,133  
SO TO UNDERSTAND HOW  
ALL AIRCRAFT FLY,

68  
00:03:54,233 --> 00:03:58,766  
IT HELPS TO SEE HOW  
THE JET-MEN TAKE TO THE SKIES.

69  
00:04:00,466 --> 00:04:04,500  
IT MIGHT NOT LOOK LIKE YOUR  
AVERAGE IN-FLIGHT EXPERIENCE.

70  
00:04:04,600 --> 00:04:07,533  
THEY DON'T TAKE OFF  
FROM A RUNWAY.

71  
00:04:13,800 --> 00:04:17,399  
THEY JUMP FROM A HELICOPTER.

72  
00:04:17,500 --> 00:04:19,366  
BUT ONCE THEY'RE FLYING  
ON THEIR OWN,

73  
00:04:19,466 --> 00:04:22,666  
THERE'S A LOT MORE IN COMMON THAN YOU MIGHT THINK.

74  
00:04:24,500 --> 00:04:26,100  
INITIALLY THEY PLUMMET  
TOWARDS THE GROUND

75  
00:04:26,200 --> 00:04:28,633  
WITH THEIR JET PACKS  
ON FULL THRUST

76  
00:04:28,733 --> 00:04:34,133  
TO PICK UP SPEED AND INCREASE  
AIR FLOW OVER THEIR WINGS...

77  
00:04:34,233 --> 00:04:36,200  
THE SAME THING  
A PASSENGER PLANE MUST DO

78

00:04:36,300 --> 00:04:38,733  
BEFORE IT CAN TAKE OFF.

79

00:04:44,266 --> 00:04:47,333  
AND JUST LIKE A PLANE,  
THE SHAPE OF THEIR WING

80

00:04:47,433 --> 00:04:49,800  
CAUSES LOWER PRESSURE  
ON ITS TOP SURFACE

81

00:04:49,900 --> 00:04:54,066  
THAN ON THE BOTTOM,  
CREATING A FORCE CALLED LIFT.

82

00:04:54,166 --> 00:04:57,600  
BUT THE KEY TO CONTROLLING  
THE FLIGHT OF ANY JET AIRCRAFT

83

00:04:57,700 --> 00:05:00,566  
IS THE ANGLE OF THE WING.

84

00:05:00,666 --> 00:05:02,300  
WHEN THE JET-MEN  
ARCH THEIR BACKS,

85

00:05:02,400 --> 00:05:04,166  
THEIR WINGS TILT UPWARDS,

86

00:05:04,266 --> 00:05:07,933  
JUST ENOUGH THAT THE LIFT  
COUNTERACTS THE PULL OF GRAVITY.

87

00:05:09,933 --> 00:05:13,400  
THIS CREATES CONTROLLED,  
LEVEL FLIGHT.

88

00:05:15,066 --> 00:05:18,533  
WHERE AIRLINERS USE A RUDDER AND AILERONS TO STEER,

89

00:05:18,633 --> 00:05:21,800  
THE JET-MEN USE  
THEIR HANDS AND BODIES.

90

00:05:21,900 --> 00:05:26,166  
BUT THE PRINCIPLE OF LIFT

IS THE SAME.

91

00:05:26,266 --> 00:05:30,966  
IT'S ALL ABOUT THE MOTION  
OF AIR AND SPEED.

92

00:05:37,600 --> 00:05:42,000  
WHEN YOU'RE IN FLIGHT, AIR  
RUSHES UNDER AND OVER THE WINGS,

93

00:05:42,100 --> 00:05:45,300  
KEEPING YOUR PLANE IN THE SKY,

94

00:05:45,400 --> 00:05:48,000  
AND IT MIGHT NOT FEEL LIKE IT,  
BUT IN THOSE LONG HOURS

95

00:05:48,100 --> 00:05:50,066  
CRUISING AT 30,000 FEET,

96

00:05:50,166 --> 00:05:53,566  
YOU'RE MOVING AT OVER  
500 MILES AN HOUR.

97

00:05:55,166 --> 00:05:57,666  
THAT'S SO FAST THAT IF  
YOUR PLANE WAS POINTED

98

00:05:57,766 --> 00:06:00,466  
IN JUST SLIGHTLY  
THE WRONG DIRECTION,

99

00:06:00,566 --> 00:06:04,333  
YOU'D END UP HUNDREDS  
OF MILES OFF COURSE.

100

00:06:06,500 --> 00:06:09,466  
THERE'S LITTLE ROOM  
FOR NAVIGATIONAL ERROR,

101

00:06:09,566 --> 00:06:12,733  
SO PILOTS NEED A TOTALLY  
RELIABLE SYSTEM

102

00:06:12,833 --> 00:06:15,566  
TO FIND THEIR WAY  
THROUGH THE SKY.



103  
00:06:17,100 --> 00:06:21,533  
TONIGHT, LUFTHANSA SENIOR PILOT  
CAPTAIN JOACHIM SCHWARZENBERG

104  
00:06:21,633 --> 00:06:24,900  
IS FLYING ONE OF THE BIGGEST  
PASSENGER JETS IN THE WORLD,

105  
00:06:25,000 --> 00:06:27,733  
WITH 480 PEOPLE ON BOARD,

106  
00:06:27,833 --> 00:06:30,466  
FROM FRANKFURT TO DELHI.

107  
00:06:32,133 --> 00:06:35,066  
PROBLEM IS, FOR MOST OF  
THE 4,000-MILE JOURNEY,

108  
00:06:35,166 --> 00:06:37,400  
HE CAN'T SEE A THING  
OUT OF THE WINDOW.

109  
00:06:37,500 --> 00:06:40,400  
[INDISTINCT RADIO TRANSMISSION]

110  
00:06:40,500 --> 00:06:44,600  
SO HOW DOES HE KNOW WHERE TO GO?

111  
00:06:44,700 --> 00:06:47,300  
THE ANSWER LIES WITH ONE  
OF THE CITY IN THE SKY'S

112  
00:06:47,400 --> 00:06:52,100  
MOST IMPORTANT HIDDEN NETWORKS:  
A WEB OF LOCATION MARKERS

113  
00:06:52,200 --> 00:06:55,966  
DOTTED ACROSS THE PLANET  
KNOWN AS WAYPOINTS.

114  
00:06:56,066 --> 00:06:57,666  
SCHWARZENBERG:  
TO FLY FROM "A"  
TO "B,"

115  
00:06:57,766 --> 00:06:59,400  
WE HAVE TO HAVE

AN IDEA

116

00:06:59,500 --> 00:07:00,533

HOW WE WOULD LIKE  
TO FLY,

117

00:07:00,633 --> 00:07:02,166

SO WE FILE  
A FLIGHT PLAN

118

00:07:02,266 --> 00:07:04,733

WHICH GOES FROM  
LANDMARK TO LANDMARK  
TO LANDMARK

119

00:07:04,833 --> 00:07:05,866  
IN EARLIER TIMES.

120

00:07:05,966 --> 00:07:07,366

NOWADAYS,  
WE ARE FLYING

121

00:07:07,466 --> 00:07:09,833

FROM WAYPOINT  
TO WAYPOINT  
TO WAYPOINT.

122

00:07:12,666 --> 00:07:15,733

NARRATOR: MOST WAYPOINTS  
AREN'T PHYSICAL BEACONS

123

00:07:15,833 --> 00:07:18,900

OR EVEN REAL PLACES  
ON THE GROUND.

124

00:07:19,000 --> 00:07:21,333

SCHWARZENBERG:  
THERE USED TO BE  
PHYSICAL OBJECTS

125

00:07:21,433 --> 00:07:22,666

IN EARLIER DAYS,

126

00:07:22,766 --> 00:07:24,400

BUT NOWADAYS WITH  
THE USE OF GPS,

127

00:07:24,500 --> 00:07:26,633

IT'S ALL  
COORDINATES.

128  
00:07:26,733 --> 00:07:29,000  
WE DEFINE POINTS  
IN THE AIR

129  
00:07:29,100 --> 00:07:30,166  
SOMEWHERE OVER  
THE EARTH,

130  
00:07:30,266 --> 00:07:33,466  
GIVE THEM A NAME--  
IT'S A 5-LETTER  
NAME--

131  
00:07:33,566 --> 00:07:36,033  
AND THEN WE FLY  
FROM WAYPOINT  
TO WAYPOINT.

132  
00:07:38,166 --> 00:07:41,000  
NARRATOR: WAYPOINTS ARE LIKE IMAGINARY SIGNPOSTS

133  
00:07:41,100 --> 00:07:43,633  
REACHING INTO THE SKY.

134  
00:07:43,733 --> 00:07:47,466  
THESE VIRTUAL LANDMARKS TELL  
THE PLANE'S NAVIGATION SYSTEMS

135  
00:07:47,566 --> 00:07:51,400  
EXACTLY WHERE IT IS  
AND WHICH WAY IT'S HEADING.

136  
00:07:51,500 --> 00:07:55,766  
THEY GIVE PILOTS A TRAIL  
TO FOLLOW THROUGH THE NIGHT.

137  
00:07:55,866 --> 00:07:57,300  
AND ON A FAMILIAR ROUTE,

138  
00:07:57,400 --> 00:08:01,100  
THEIR NAMES GET BURNED  
INTO A PILOT'S MEMORY.

139  
00:08:01,200 --> 00:08:03,633  
OUR NEXT WAYPOINT

IS NEVIV,

140

00:08:03,733 --> 00:08:06,466  
AND WE ARE FLYING  
FURTHER ON TO PATAX,

141

00:08:06,566 --> 00:08:08,000  
MESRA, AND PAVLO,

142

00:08:08,100 --> 00:08:11,266  
AND PAVLO IS  
THE ENTRY POINT  
TO INDIA,

143

00:08:11,366 --> 00:08:12,433  
AND IT'S ALSO  
THE EXIT POINT

144

00:08:12,533 --> 00:08:14,800  
OF, UH, AFGHANISTAN.

145

00:08:14,900 --> 00:08:16,466  
SO FOLLOWING  
THESE WAYPOINTS,

146

00:08:16,566 --> 00:08:19,166  
IT'S JUST LIKE  
FOLLOWING A TRAIL  
OF BREADCRUMBS.

147

00:08:19,266 --> 00:08:22,066  
UH, WE HAVE ABOUT  
5,000, 6,000 MILES,

148

00:08:22,166 --> 00:08:24,966  
AND SOMETIMES  
THE SPACING OF  
THESE WAYPOINTS

149

00:08:25,066 --> 00:08:27,333  
IS JUST 20,  
40 MILES,

150

00:08:27,433 --> 00:08:29,533  
SO IT'S QUITE A LOT.

151

00:08:31,500 --> 00:08:34,900  
NARRATOR: WHILE WE PASSENGERS

ARE WATCHING THE NEXT MOVIE,

152

00:08:35,000 --> 00:08:39,500  
THE PILOT IS WATCHING OUT  
FOR THE NEXT WAYPOINT.

153

00:08:39,600 --> 00:08:41,900  
BUT JUST LIKE THE GPS  
IN YOUR CAR,

154

00:08:42,000 --> 00:08:44,566  
THE NAVIGATION SYSTEM  
CAN'T TELL A PILOT

155

00:08:44,666 --> 00:08:47,266  
WHAT ALL THE OTHER  
TRAFFIC IS DOING,

156

00:08:47,366 --> 00:08:48,433  
AND SOMETIMES THERE ARE

157

00:08:48,533 --> 00:08:51,833  
A LOT OF OTHER AIRCRAFT  
TO THINK ABOUT.

158

00:08:53,133 --> 00:08:55,566  
EACH ONE OF THESE LINES  
REPRESENTS THE PATH

159

00:08:55,666 --> 00:09:00,066  
OF A REAL PLANE BASED ON RADAR  
AND TRANSPONDER DATA.

160

00:09:00,166 --> 00:09:01,900  
OVER 24 HOURS, AIR TRAFFIC

161

00:09:02,000 --> 00:09:04,800  
REACHES INTO EVERY CORNER  
OF THE GLOBE,

162

00:09:04,900 --> 00:09:07,300  
ADDING UP TO OVER  
100,000 FLIGHTS

163

00:09:07,400 --> 00:09:11,966  
CRISS-CROSSING OUR PLANET  
EVERY SINGLE DAY.

164  
00:09:12,066 --> 00:09:14,500  
BY 2034, IT'S PREDICTED  
THERE WILL BE

165  
00:09:14,600 --> 00:09:19,766  
OVER 44,000 PASSENGER JETS  
IN OPERATION WORLDWIDE.

166  
00:09:21,100 --> 00:09:23,466  
BUT WHILE ANOTHER PLANE  
ZIPPING BY YOUR WINDOW

167  
00:09:23,566 --> 00:09:27,166  
MAY LOOK TOO CLOSE FOR COMFORT,

168  
00:09:27,266 --> 00:09:31,500  
IT'S NO ACCIDENT THAT MIDAIR COLLISIONS ARE RARE.

169  
00:09:34,266 --> 00:09:37,566  
BECAUSE THERE'S SOMEONE  
WATCHING OVER IT ALL...

170  
00:09:37,666 --> 00:09:43,633  
A HIGHLY SKILLED GLOBAL ARMY  
OF AIR TRAFFIC CONTROLLERS.

171  
00:09:43,733 --> 00:09:45,466  
ONE OF THEIR MOST  
IMPORTANT NERVE CENTERS

172  
00:09:45,566 --> 00:09:49,933  
IS JUST OUTSIDE  
ATLANTA, GEORGIA.

173  
00:09:50,033 --> 00:09:54,166  
80% OF AMERICANS LIVE WITHIN  
3 HOURS' FLYING TIME OF ATLANTA,

174  
00:09:54,266 --> 00:09:58,166  
AND TRANSATLANTIC FLIGHTS  
CONTINUALLY CROSS THE AREA.

175  
00:10:00,700 --> 00:10:04,400  
THE 130,000 SQUARE MILES  
OF AIRSPACE ABOVE ATLANTA

176  
00:10:04,500 --> 00:10:08,133

ARE CRITICAL TO THE ENTIRE  
U.S. AVIATION SYSTEM.

177  
00:10:09,633 --> 00:10:12,800  
IT'S THE BUSIEST AIRSPACE  
ON THE PLANET,

178  
00:10:12,900 --> 00:10:15,933  
AND IT'S ALL MANAGED  
FROM THIS UNASSUMING ROOM.

179  
00:10:16,033 --> 00:10:18,666  
[INDISTINCT RADIO TRANSMISSION]

180  
00:10:18,766 --> 00:10:20,500  
THE JOB OF THE CONTROLLERS HERE

181  
00:10:20,600 --> 00:10:23,100  
IS TO SEE THAT PLANES  
NEVER COLLIDE

182  
00:10:23,200 --> 00:10:26,800  
BY FINE-TUNING THEIR ROUTES.

183  
00:10:26,900 --> 00:10:28,933  
AIR TRAFFIC MANAGER  
SHAUN SANDERS

184  
00:10:29,033 --> 00:10:32,566  
HAS ULTIMATE RESPONSIBILITY  
FOR ENSURING THIS VITAL SYSTEM

185  
00:10:32,666 --> 00:10:35,200  
WORKS WITHOUT A HITCH.

186  
00:10:35,300 --> 00:10:36,733  
SO, WHAT YOU'RE  
SEEING BEHIND ME

187  
00:10:36,833 --> 00:10:39,266  
IS THE CONTINENTAL  
UNITED STATES

188  
00:10:39,366 --> 00:10:42,000  
AND UP NORTH, CANADA,  
AND SOUTH, MEXICO,

189

00:10:42,100 --> 00:10:44,233  
AND THAT'S EVERY PLANE  
THAT'S FLYING

190  
00:10:44,333 --> 00:10:46,000  
OVER THE CONTINENTAL  
UNITED STATES RIGHT NOW.

191  
00:10:46,100 --> 00:10:49,000  
THAT'S ALMOST 6,000  
PLANES YOU SEE  
BEHIND ME,

192  
00:10:49,100 --> 00:10:51,366  
UM, TRANSITIONING,  
LANDING, DEPARTING,

193  
00:10:51,466 --> 00:10:52,766  
WHEREVER THEY MAY BE  
GOING.

194  
00:10:52,866 --> 00:10:55,300  
SO IT MIGHT LOOK LIKE  
A DISORGANIZED SWARM,

195  
00:10:55,400 --> 00:10:57,366  
BUT IT'S ACTUALLY  
QUITE ORGANIZED.

196  
00:10:57,466 --> 00:10:59,633  
THEY'RE FOLLOWING  
AN INVISIBLE HIGHWAY  
IN THE SKY,

197  
00:10:59,733 --> 00:11:02,466  
AND THEY'RE SEPARATED  
BY WHAT WE CALL

198  
00:11:02,566 --> 00:11:03,866  
OUR STANDARD SEPARATION.

199  
00:11:03,966 --> 00:11:06,300  
THEY'LL EITHER BE  
1,000 FEET VERTICAL

200  
00:11:06,400 --> 00:11:09,533  
OR 5 MILES LATERAL,  
SO WHEN YOU LOOK  
AT THE SCREEN,



201

00:11:09,633 --> 00:11:11,066

IT LOOKS LIKE THEY'RE  
ALL OVER THE PLACE,

202

00:11:11,166 --> 00:11:12,600

THEY'RE ON TOP  
OF ONE ANOTHER,

203

00:11:12,700 --> 00:11:14,900

BUT IN ACTUALITY,  
THEY'RE SPACED OUT

204

00:11:15,000 --> 00:11:17,600

BY AT LEAST 5 MILES  
AND 1,000 FEET.

205

00:11:20,800 --> 00:11:23,066

NARRATOR: AIR TRAFFIC CONTROLLERS ACROSS THE WORLD

206

00:11:23,166 --> 00:11:27,333

SHARE THE SAME SYSTEM  
FOR PREVENTING COLLISIONS.

207

00:11:27,433 --> 00:11:31,633

BY HERDING AIRCRAFT INTO THOSE  
INVISIBLE HIGHWAYS IN THE SKY,

208

00:11:31,733 --> 00:11:36,233

THEY KNOW THAT PLANES WILL BE  
FOLLOWING PREDETERMINED LANES.

209

00:11:36,333 --> 00:11:37,966

THIS ALLOWS THEM TO CONTROL

210

00:11:38,066 --> 00:11:41,600

THEIR SPEED AND SPACING  
MORE EASILY.

211

00:11:41,700 --> 00:11:44,033

BUT UNLIKE HIGHWAYS  
ON THE GROUND,

212

00:11:44,133 --> 00:11:46,566

THOSE AIRWAYS ARE  
ACTUALLY DEEP CANYONS

213

00:11:46,666 --> 00:11:49,100  
WITHIN THE EARTH'S ATMOSPHERE,

214  
00:11:49,200 --> 00:11:52,266  
AND THAT EXTRA THIRD DIMENSION  
GIVES THE CONTROLLERS

215  
00:11:52,366 --> 00:11:56,633  
VERTICAL SPACE TO WORK WITH  
WHEN TRAFFIC INCREASES.

216  
00:11:58,166 --> 00:12:00,000  
[INDISTINCT RADIO TRANSMISSION]

217  
00:12:00,100 --> 00:12:05,400  
ON AN ORDINARY DAY, ATLANTA'S  
AIRSPACE IS BUSY ENOUGH.

218  
00:12:05,500 --> 00:12:09,200  
BUT THIS IS THE BUILDUP  
TO THANKSGIVING.

219  
00:12:09,300 --> 00:12:10,966  
THE ATLANTA CONTROLLERS  
ARE DEALING

220  
00:12:11,066 --> 00:12:16,133  
WITH MORE FLIGHTS THIS WEEK THAN  
AT ANY OTHER TIME OF THE YEAR...

221  
00:12:16,233 --> 00:12:18,500  
[INDISTINCT RADIO TRANSMISSION]

222  
00:12:18,600 --> 00:12:22,000  
RISING TO A STAGGERING PEAK  
OF 9,000 FLIGHTS

223  
00:12:22,100 --> 00:12:26,000  
CROSSING THEIR AIRSPACE  
IN A DAY.

224  
00:12:26,100 --> 00:12:27,700  
THAT MEANS ON AVERAGE,

225  
00:12:27,800 --> 00:12:30,933  
AROUND ONE NEW PLANE  
APPEARS ON THEIR SCREENS

226

00:12:31,033 --> 00:12:33,333  
EVERY 10 SECONDS.

227

00:12:33,433 --> 00:12:35,200  
THEY'VE GOT TO DO  
EVERYTHING IN THEIR POWER

228

00:12:35,300 --> 00:12:38,366  
TO PREVENT AVIATION GRIDLOCK.

229

00:12:38,466 --> 00:12:42,166  
IT TAKES INTENSE FOCUS  
AND CONCENTRATION.

230

00:12:42,266 --> 00:12:44,100  
EVERY HOUR OF THEIR WORKING DAY,

231

00:12:44,200 --> 00:12:48,000  
THE CONTROLLERS HOLD THE LIVES  
OF OVER 50,000 PASSENGERS

232

00:12:48,100 --> 00:12:49,833  
IN THEIR HANDS.

233

00:12:49,933 --> 00:12:53,266  
ONE SMALL ERROR COULD BE FATAL.

234

00:12:53,366 --> 00:12:55,233  
SANDERS: TO US, THIS IS  
WHAT WE DO.

235

00:12:55,333 --> 00:12:57,700  
THIS IS WHAT  
WE GET PAID TO DO.  
IT'S NORMAL.

236

00:12:57,800 --> 00:12:59,366  
THIS IS YEARS AND YEARS  
OF TRAINING,

237

00:12:59,466 --> 00:13:02,233  
YEARS AND YEARS OF  
DOING IT OVER AND OVER  
AND OVER,

238

00:13:02,333 --> 00:13:03,733  
DAY IN AND DAY OUT.

239

00:13:03,833 --> 00:13:07,700  
UM, WE DON'T THINK ABOUT  
THE NUMBER OF PEOPLE  
ON THE PLANES.

240

00:13:07,800 --> 00:13:09,066  
IT'S JUST ONE PLANE  
AT A TIME,

241

00:13:09,166 --> 00:13:11,133  
GETTING IT FROM  
POINT "A" TO POINT "B,"

242

00:13:11,233 --> 00:13:14,133  
GETTING IT THERE  
AS FAST AS WE CAN,  
AS EFFICIENT AS WE CAN,

243

00:13:14,233 --> 00:13:17,000  
AND AS SAFE AS WE CAN,  
AND THAT'S HOW WE  
LOOK AT IT.

244

00:13:17,100 --> 00:13:20,300  
I'VE NEVER WOKEN UP  
AT NIGHT WITH HOT  
SWEATS THINKING ABOUT,

245

00:13:20,400 --> 00:13:22,800  
"OH, MY GOD!  
THERE'S THOUSANDS  
AND THOUSANDS--"

246

00:13:22,900 --> 00:13:25,866  
ONE PLANE AT A TIME  
IS HOW WE ALWAYS  
LOOK AT IT.

247

00:13:28,733 --> 00:13:30,066  
NARRATOR: BUT AIR TRAFFIC  
CONTROLLERS

248

00:13:30,166 --> 00:13:34,233  
AREN'T THE ONLY PEOPLE  
MONITORING YOUR FLIGHT.

249

00:13:34,333 --> 00:13:37,200  
WE'VE ALL WONDERED

ABOUT THAT PASSENGER--

250

00:13:37,300 --> 00:13:39,600  
YOU KNOW, THE ONE JUST  
A FEW ROWS BEHIND YOU

251

00:13:39,700 --> 00:13:44,633  
WHO WAS PALE AND SWEATING  
AND DIDN'T LOOK SO GOOD.

252

00:13:44,733 --> 00:13:48,000  
WELL, HE MIGHT BE MOMENTS AWAY  
FROM A HEART ATTACK.

253

00:13:48,100 --> 00:13:51,200  
[SIREN]

254

00:13:51,300 --> 00:13:53,433  
AND IF THE WORST HAPPENS,

255

00:13:53,533 --> 00:13:56,033  
THERE'S A TEAM OF EMERGENCY  
SPECIALISTS

256

00:13:56,133 --> 00:13:58,633  
YOUR CABIN CREW CAN CALL ON.

257

00:14:02,733 --> 00:14:05,733  
BANNER UNIVERSITY MEDICAL CENTER  
SEES A STEADY STREAM

258

00:14:05,833 --> 00:14:10,400  
OF EMERGENCY PATIENTS  
FROM PHOENIX.

259

00:14:10,500 --> 00:14:13,766  
BUT MANY OF THE MEDICAL DRAMAS  
THEY DEAL WITH HERE

260

00:14:13,866 --> 00:14:17,100  
TAKE PLACE THOUSANDS  
OF MILES AWAY.

261

00:14:17,200 --> 00:14:19,366  
PLEASE GO AHEAD  
WITH THE PASSENGER AGE,

262

00:14:19,466 --> 00:14:20,533  
GENDER, AND SEAT  
ASSIGNMENT.

263  
00:14:20,633 --> 00:14:21,700  
DIFFERENT WOMAN:  
OK, YOU GO AHEAD

264  
00:14:21,800 --> 00:14:24,266  
AND MAKE THE MEDICAL  
ARRANGEMENTS  
FOR THE CHILD.

265  
00:14:24,366 --> 00:14:26,333  
NARRATOR: IF YOU'RE FLYING  
ON A MAJOR AIRLINE

266  
00:14:26,433 --> 00:14:30,333  
AND YOU GET SICK, THE CHANCES  
ARE THE CABIN CREW WILL TALK

267  
00:14:30,433 --> 00:14:35,266  
TO THE MEDICS IN THIS VERY ROOM  
TO FIND OUT WHAT TO DO,

268  
00:14:35,366 --> 00:14:38,500  
NO MATTER WHERE YOU ARE  
IN THE WORLD.

269  
00:14:40,600 --> 00:14:42,400  
THIS IS ONE OF SEVERAL COMPANIES

270  
00:14:42,500 --> 00:14:46,566  
THAT HANDLE MID-AIR  
MEDICAL EMERGENCIES.

271  
00:14:46,666 --> 00:14:50,100  
DR. BHOW AT MEDLINK.  
HOW DO YOU COPY? OVER.

272  
00:14:50,200 --> 00:14:53,500  
NARRATOR: DR. MONEESH BHOW  
HAS JUST STARTED HIS SHIFT

273  
00:14:53,600 --> 00:14:56,766  
AND IS RESPONDING  
TO HIS FIRST EMERGENCY,

274

00:14:56,866 --> 00:14:58,133  
A CALL FROM AN AIRCRAFT

275  
00:14:58,233 --> 00:15:01,200  
TRAVELING FROM THE MIDDLE EAST  
TO BANGKOK,

276  
00:15:01,300 --> 00:15:05,100  
8,000 MILES AWAY, SOMEWHERE  
OVER THE INDIAN OCEAN.

277  
00:15:05,200 --> 00:15:06,766  
I UNDERSTAND  
AN 82-YEAR-OLD MALE

278  
00:15:06,866 --> 00:15:08,700  
WITH A POSSIBLE STROKE.

279  
00:15:08,800 --> 00:15:10,966  
WHAT WAS THE CONDITION,  
UH, THAT BROUGHT HIM

280  
00:15:11,066 --> 00:15:13,033  
TO YOUR ATTENTION?  
OVER.

281  
00:15:15,266 --> 00:15:17,466  
NARRATOR: FOR DR. BHOW,  
PRESSURE'S NOW ON

282  
00:15:17,566 --> 00:15:20,466  
TO MAKE A QUICK DIAGNOSIS.

283  
00:15:20,566 --> 00:15:23,333  
BHOW: OK. COPY THAT.  
SO THE PASSENGER  
WAS STANDING.

284  
00:15:23,433 --> 00:15:25,833  
HE PASSED OUT,  
IS CURRENTLY ON THE FLOOR.

285  
00:15:25,933 --> 00:15:29,233  
IS HE ABLE TO ANSWER  
ANY QUESTIONS? OVER.

286  
00:15:30,466 --> 00:15:34,500  
OK. IS HE--IS HE

BREATHING ON HIS OWN?

287

00:15:34,600 --> 00:15:37,333  
NARRATOR: HE'S DEPENDING  
ON THE CAPTAIN AND CABIN CREW

288

00:15:37,433 --> 00:15:40,333  
TO ACCURATELY RELAY  
THE PATIENT'S SYMPTOMS.

289

00:15:40,433 --> 00:15:42,700  
OK, COPY THAT.  
SO, WHAT WE NEED  
TO FIND OUT,

290

00:15:42,800 --> 00:15:45,500  
IF HE'S STILL  
NOT RESPONDING  
BUT HE IS BREATHING,

291

00:15:45,600 --> 00:15:47,566  
I NEED TO KNOW  
WHAT HIS VITAL SIGNS ARE,

292

00:15:47,666 --> 00:15:51,033  
AND IS THERE ANY  
SPONTANEOUS MOVEMENT  
TO HIS ARMS OR LEGS,

293

00:15:51,133 --> 00:15:52,600  
OR IS THERE A PART  
OF HIS BODY

294

00:15:52,700 --> 00:15:55,766  
THAT HE'S NOT MOVING?  
OVER.

295

00:15:55,866 --> 00:15:57,766  
I'M SORRY. THAT LAST  
TRANSMISSION CUT OUT.

296

00:15:57,866 --> 00:16:00,266  
COULD YOU PLEASE  
REPEAT? OVER.

297

00:16:00,366 --> 00:16:03,300  
CAPTAIN, ARE YOU  
STILL ON THE LINE? OVER.



298  
00:16:03,400 --> 00:16:04,800  
NARRATOR: THEY'VE LOST CONTACT.

299  
00:16:06,366 --> 00:16:08,066  
BHOW: STROKE.

300  
00:16:08,166 --> 00:16:09,500  
DUBAI TO LAGOS.

301  
00:16:12,233 --> 00:16:13,666  
OK.

302  
00:16:13,766 --> 00:16:15,500  
NARRATOR: IF IT DOES TURN OUT  
TO BE A STROKE,

303  
00:16:15,600 --> 00:16:16,500  
THEY'LL NEED TO GET THE PATIENT

304  
00:16:16,600 --> 00:16:19,100  
ON THE GROUND  
AS SOON AS POSSIBLE.

305  
00:16:24,400 --> 00:16:25,633  
AFTER THAT...

306  
00:16:30,633 --> 00:16:33,300  
NARRATOR: FIRST, THE TEAM NEEDS  
TO CONSULT THEIR DATABASE

307  
00:16:33,400 --> 00:16:34,900  
AND DETERMINE WHICH AIRPORTS

308  
00:16:35,000 --> 00:16:38,200  
HAVE THE RIGHT MEDICAL  
FACILITIES CLOSE BY.

309  
00:16:40,566 --> 00:16:42,166  
OF THE AIRPORTS WITHIN RANGE,

310  
00:16:42,266 --> 00:16:46,500  
ONLY TWO HAVE THE NECESSARY  
EQUIPMENT TO TREAT A STROKE.

311  
00:16:48,066 --> 00:16:50,066  
NEITHER ARE EN ROUTE.

312  
00:16:50,166 --> 00:16:55,233  
OPTION ONE IS DELHI,  
700 MILES OUT OF THEIR WAY.

313  
00:16:55,333 --> 00:17:00,133  
OPTION TWO IS BEHIND THEM  
BUT CLOSER--MUSCAT.

314  
00:17:07,066 --> 00:17:08,133  
NARRATOR: A FEW MINUTES LATER,

315  
00:17:08,233 --> 00:17:10,700  
AND THE CREW ARE BACK  
ON THE LINE.

316  
00:17:10,800 --> 00:17:15,300  
IS THE PASSENGER  
AWAKE NOW? OVER.

317  
00:17:15,400 --> 00:17:16,800  
CAN HE--CAN HE  
SPEAK AT ALL?

318  
00:17:16,900 --> 00:17:21,333  
IS HE ABLE TO  
SPEAK NORMALLY  
TO HIS SON? OVER.

319  
00:17:21,433 --> 00:17:22,800  
OK, SO HE STARTED CHOKING,

320  
00:17:22,900 --> 00:17:25,066  
AND THAT'S WHAT  
CAUSED HIM TO FAINT.

321  
00:17:25,166 --> 00:17:27,133  
IS THAT WHAT  
I'M UNDERSTANDING?

322  
00:17:30,966 --> 00:17:32,700  
NARRATOR: IT SEEMS THAT  
THE PASSENGER COLLAPSED

323  
00:17:32,800 --> 00:17:36,300  
NOT BECAUSE OF A STROKE BUT  
BECAUSE HE HAD CHOKED ON FOOD,

324  
00:17:36,400 --> 00:17:39,366  
UNNOTICED BY THE CABIN CREW.

325  
00:17:39,466 --> 00:17:41,533  
HE HAS NOW WOKEN UP  
AND, FOR THE MOMENT,

326  
00:17:41,633 --> 00:17:44,766  
APPEARS TO HAVE RECOVERED.

327  
00:17:44,866 --> 00:17:47,333  
OK, BUT WE WOULD  
STILL LIKE AN UPDATE  
IN 30 MINUTES

328  
00:17:47,433 --> 00:17:50,600  
AS TO HIS CONDITION.  
OVER.

329  
00:17:50,700 --> 00:17:53,766  
NARRATOR: THIS EMERGENCY  
SEEMS TO BE OVER.

330  
00:17:56,966 --> 00:18:00,266  
BUT WITH A MILLION PEOPLE  
IN THE AIR AT ANY ONE TIME,

331  
00:18:00,366 --> 00:18:03,766  
MEDICAL CRISES IN FLIGHT  
ARE INEVITABLE.

332  
00:18:03,866 --> 00:18:05,366  
WHEN SHE  
FAINTED, UH,

333  
00:18:05,466 --> 00:18:06,966  
DID SHE FALL DOWN

334  
00:18:07,066 --> 00:18:08,533  
FROM A STANDING  
POSITION?

335  
00:18:08,633 --> 00:18:09,700  
WAS SHE IN HER SEAT?

336  
00:18:09,800 --> 00:18:10,766  
NARRATOR: THE TEAM

IN PHOENIX

337

00:18:10,866 --> 00:18:13,433  
HANDLE 38,000 CALLS  
A YEAR.

338

00:18:13,533 --> 00:18:15,900  
OK. IS SHE ACTIVELY  
RETCING NOW?

339

00:18:16,000 --> 00:18:17,533  
NARRATOR: THEIR OPERATORS  
FIELD THE CALLS

340

00:18:17,633 --> 00:18:20,133  
TO EMERGENCY DOCTORS  
TRAINED IN HANDLING

341

00:18:20,233 --> 00:18:23,700  
MEDICAL SITUATIONS  
OVER A SATELLITE PHONE.

342

00:18:23,800 --> 00:18:26,366  
I'D LIKE YOU  
TO GIVE HER  
ONE TABLET...

343

00:18:26,466 --> 00:18:29,933  
NARRATOR: DR. DAVID STREITWIESER  
IS THE SENIOR EMERGENCY DOCTOR

344

00:18:30,033 --> 00:18:33,766  
TASKED WITH OVERSEEING  
THIS FACILITY.

345

00:18:33,866 --> 00:18:34,900  
STREITWIESER:  
WITH NAUSEA, VOMITING,

346

00:18:35,000 --> 00:18:36,433  
IT'S RARELY ANYTHING SERIOUS.

347

00:18:36,533 --> 00:18:38,266  
I CAN MANAGE MOST  
OF THE SYMPTOMS.

348

00:18:38,366 --> 00:18:41,733  
BUT WHEN I'M TRYING TO RULE OUT

A SERIOUS PROBLEM,

349

00:18:41,833 --> 00:18:44,233

THAT'S THE HARD PART.

350

00:18:44,333 --> 00:18:48,100

SO I CAN'T SEE PASSENGERS.

I CAN'T TALK DIRECTLY TO THEM.

351

00:18:48,200 --> 00:18:50,833

WE HAVE TO RELY ON THE CABIN

CREW DOING THAT,

352

00:18:50,933 --> 00:18:54,700

SO THEY LITERALLY ARE

OUR EYES AND EARS AND HANDS

353

00:18:54,800 --> 00:18:58,166

UNTIL WE CAN GET, PERHAPS,

A MEDICAL PERSON INVOLVED.

354

00:19:01,366 --> 00:19:02,766

NARRATOR: MEDAIRE

HANDLES EMERGENCIES

355

00:19:02,866 --> 00:19:04,433

FROM AROUND THE GLOBE,

356

00:19:04,533 --> 00:19:08,300

SO THE CALLS CAN COME IN AT ANY TIME OF DAY OR NIGHT.

357

00:19:08,400 --> 00:19:10,633

IT'S A CONSTANT STREAM.

358

00:19:12,400 --> 00:19:15,933

BUT SOMETIMES THERE'S A MEDICAL

PROBLEM THAT'S SIMPLY TOO SEVERE

359

00:19:16,033 --> 00:19:18,433

TO BE TREATED IN THE AIR.

360

00:19:18,533 --> 00:19:20,133

HE IS NOW HAVING

TROUBLE BREATHING,

361

00:19:20,233 --> 00:19:22,533

AND THE REPEAT PULSE

IS 240.

362

00:19:22,633 --> 00:19:25,366  
IS THAT CORRECT? OVER.

363

00:19:25,466 --> 00:19:27,266  
NARRATOR: DR. MONEESH BHOW  
HAS BEEN CALLED BACK

364

00:19:27,366 --> 00:19:30,366  
BY THE FLIGHT HE WAS  
HELPING OUT AN HOUR AGO.

365

00:19:30,466 --> 00:19:33,600  
THE PASSENGER WHO THEN  
SEEMED TO BE RECOVERING

366

00:19:33,700 --> 00:19:37,033  
HAS NOW TAKEN A TURN  
FOR THE WORSE.

367

00:19:37,133 --> 00:19:38,600  
BHOW: LET'S CONTINUE  
THE OXYGEN,

368

00:19:38,700 --> 00:19:42,066  
UH, AND LET'S PLAN  
TO LAND, UH,

369

00:19:42,166 --> 00:19:44,200  
AT THE CLOSEST  
POSSIBLE OPTION.

370

00:19:44,300 --> 00:19:46,866  
LET'S PLAN TO DIVERT  
INTO MUMBAI.

371

00:19:46,966 --> 00:19:48,400  
WE WILL HAVE MEDICAL  
PERSONNEL

372

00:19:48,500 --> 00:19:49,866  
MEET YOU ON ARRIVAL.

373

00:19:49,966 --> 00:19:51,600  
THEY ARE TURNING.

374

00:19:49,966 --> 00:19:51,600  
THEY ARE TURNING?

375  
00:19:51,700 --> 00:19:53,233  
YEAH.

376  
00:19:53,333 --> 00:19:55,533  
NARRATOR: DR. BHOW SUSPECTS  
HIS PASSENGER'S SYMPTOMS

377  
00:19:55,633 --> 00:19:59,433  
MAY BE DUE TO A SERIOUS  
HEART CONDITION,

378  
00:19:59,533 --> 00:20:04,333  
SO HE ADVISES THE CAPTAIN  
TO DIVERT TO MUMBAI.

379  
00:20:04,433 --> 00:20:06,800  
A FLIGHT DIVERSION LIKE THIS  
CAN COST AN AIRLINE

380  
00:20:06,900 --> 00:20:10,266  
HUNDREDS OF THOUSANDS  
OF DOLLARS.

381  
00:20:10,366 --> 00:20:14,900  
BUT IT'S A DILEMMA THE DOCTORS  
HERE FACE EVERY DAY.

382  
00:20:15,000 --> 00:20:16,233  
BHOW: IN A 24-HOUR  
PERIOD,

383  
00:20:16,333 --> 00:20:18,566  
WE'RE PROBABLY  
DIVERTING ONCE  
OR TWICE.

384  
00:20:18,666 --> 00:20:19,733  
BHOW: OUR ULTIMATE  
PRIORITY

385  
00:20:19,833 --> 00:20:21,966  
IS TO TAKE CARE OF  
THE PASSENGER,

386  
00:20:22,066 --> 00:20:24,133

SO IF WE FEEL  
THAT THE PASSENGER

387  
00:20:24,233 --> 00:20:26,633  
IS--IS IN CRITICAL  
NEED OF GETTING  
ON THE GROUND,

388  
00:20:26,733 --> 00:20:30,266  
THEN, YOU KNOW,  
COST IS A SECONDARY  
CONSIDERATION.

389  
00:20:30,366 --> 00:20:32,433  
UM, BUT IT IS  
PROBABLY THE MOST  
STRESSFUL CALL

390  
00:20:32,533 --> 00:20:36,233  
THAT WE TAKE WHEN  
WE MAKE A DECISION  
FOR A DIVERSION.

391  
00:20:36,333 --> 00:20:37,833  
NARRATOR: AS SOON  
AS THE FLIGHT LANDS,

392  
00:20:37,933 --> 00:20:39,666  
THEY'LL RUSH THE PATIENT  
TO A HOSPITAL,

393  
00:20:39,766 --> 00:20:42,333  
WHERE LOCAL DOCTORS  
WILL TAKE OVER.

394  
00:20:44,266 --> 00:20:47,700  
AS WITH MOST OF THESE CASES,  
DR. BHOW MAY NEVER FIND OUT

395  
00:20:47,800 --> 00:20:50,633  
WHETHER HIS PATIENT  
LIVES OR DIES.

396  
00:20:58,033 --> 00:21:02,400  
THANKFULLY, NOTHING LIKE THAT IS  
HAPPENING ON YOUR FLIGHT,

397  
00:21:02,500 --> 00:21:07,600  
SO SIT BACK, RELAX, AND MAYBE



SLIP OFF YOUR SHOES.

398

00:21:07,700 --> 00:21:09,866

BUT CONSIDER THAT

WHILE YOU'RE IN THE AIR,

399

00:21:09,966 --> 00:21:12,700

THERE MIGHT BE A LOT MORE

STOWED BENEATH YOUR FEET

400

00:21:12,800 --> 00:21:15,200

THAN JUST YOUR BAGGAGE

401

00:21:15,300 --> 00:21:21,466

BECAUSE MOVING YOU IS ONLY ONE

FUNCTION OF THE CITY IN THE SKY.

402

00:21:21,566 --> 00:21:23,766

LIKE ANY CITY

WITH TRUCKS ON THE ROAD

403

00:21:23,866 --> 00:21:25,766

AND TRAINS ON THE RAILS,

404

00:21:25,866 --> 00:21:30,300

THERE'S A WHOLE HOST OF CARGO

MOVING ALONGSIDE YOU,

405

00:21:30,400 --> 00:21:31,833

AND OUR MODERN WAY OF LIFE

406

00:21:31,933 --> 00:21:35,266

DEPENDS ON IT REACHING

ITS DESTINATION.

407

00:21:37,333 --> 00:21:40,266

BUT AT 30,000 FEET,

THAT SOMETIMES PRESENTS

408

00:21:40,366 --> 00:21:42,633

A CONSIDERABLE CHALLENGE,

409

00:21:42,733 --> 00:21:46,100

ESPECIALLY IF THE CARGO

IN QUESTION IS EXPENSIVE,

410

00:21:46,200 --> 00:21:50,066

FRAGILE, AND HAS 4 LEGS.

411

00:21:51,300 --> 00:21:53,500  
[HORSE NEIGHS]

412

00:21:53,600 --> 00:21:56,433  
THESE SHOW JUMPING HORSES  
NEED TO BE IN HONG KONG,

413

00:21:56,533 --> 00:22:02,766  
OVER 6,000 MILES AWAY,  
BY 5 P.M. TOMORROW AFTERNOON.

414

00:22:02,866 --> 00:22:04,300  
THEY'RE DESTINED  
FOR THE PRESTIGIOUS

415

00:22:04,400 --> 00:22:07,600  
LONGINES MASTERS COMPETITION.

416

00:22:07,700 --> 00:22:08,766  
[HORSE NEIGHS]

417

00:22:08,866 --> 00:22:11,666  
FIRST JOB FOR VET GORDON SIDLOW  
IS TO MAKE SURE

418

00:22:11,766 --> 00:22:14,633  
EVERY HORSE IS DISEASE-FREE.

419

00:22:14,733 --> 00:22:15,866  
THEY'LL NEED THE ALL-CLEAR

420

00:22:15,966 --> 00:22:19,633  
BEFORE BEING GIVEN  
A BOARDING PASS.

421

00:22:19,733 --> 00:22:20,966  
SIDLOW: BASICALLY  
WE HAVE TO MAKE SURE

422

00:22:21,066 --> 00:22:23,466  
THAT EVERY HORSE IS  
HEALTHY BEFORE IT GETS  
ON THE PLANE.

423

00:22:23,566 --> 00:22:25,566

THE IMPORTING COUNTRY  
WANTS TO KNOW

424

00:22:25,666 --> 00:22:29,066

THAT WE'RE NOT BRINGING  
DISEASED HORSES  
INTO THE COUNTRY.

425

00:22:32,166 --> 00:22:34,066

NARRATOR: THE LOADING TEAM  
HAVE JUST 7 HOURS

426

00:22:34,166 --> 00:22:37,466

TO GET ALL 64 HORSES  
HEALTH-CHECKED AND BOARDED

427

00:22:37,566 --> 00:22:41,066

ONTO THEIR OWN SPECIALLY  
CHARTERED PLANE--

428

00:22:41,166 --> 00:22:43,266

EASIER SAID THAN DONE.

429

00:22:46,733 --> 00:22:48,533

SIDLOW: JUST OCCASIONALLY,  
YOU WILL GET A HORSE

430

00:22:48,633 --> 00:22:50,700

THAT WE'RE NOT EXPECTING  
A PROBLEM WITH

431

00:22:50,800 --> 00:22:52,000

WILL HAVE A PROBLEM.

432

00:22:52,100 --> 00:22:55,066

IT'S THE SORT OF JOB  
WHERE SOMETHING CAN GO WRONG--

433

00:22:55,166 --> 00:22:58,400

VERY, VERY WRONG,  
VERY, VERY QUICKLY.

434

00:22:58,500 --> 00:23:00,433

NARRATOR: IN TWOS AND THREES,  
THEY'RE GUIDED

435

00:23:00,533 --> 00:23:04,033

INTO SPECIALLY DESIGNED

## AVIATION HORSE BOXES

436

00:23:04,133 --> 00:23:07,666  
THE SAME SIZE AS A STANDARD  
CARGO CONTAINER.

437

00:23:07,766 --> 00:23:11,033  
THAT MAKES IT EASY TO LOAD THEM ONTO THE PLANE.

438

00:23:11,133 --> 00:23:14,300  
BUT THE SEATING PLAN  
NEEDS SPECIAL ATTENTION.

439

00:23:14,400 --> 00:23:15,400  
SIDLOW: THERE ARE  
A FEW RULES.

440

00:23:15,500 --> 00:23:18,033  
ALL THE HORSES HAVE TO  
TRAVEL FACING FORWARDS.

441

00:23:18,133 --> 00:23:20,733  
WE GENERALLY TRY AND PUT  
THE STALLIONS AT THE FRONT.

442

00:23:20,833 --> 00:23:23,166  
STALLIONS--THE NATURAL  
REACTION TO A STALLION,

443

00:23:23,266 --> 00:23:26,433  
IF IT'S--IF IT'S STANDING  
6 INCHES BEHIND A MARE,

444

00:23:26,533 --> 00:23:29,466  
UM, AND IT CAN SMELL  
THE MARE IN FRONT OF IT,

445

00:23:29,566 --> 00:23:32,766  
IS THAT, UM, STALLIONS  
WILL DO WHAT STALLIONS DO,

446

00:23:32,866 --> 00:23:34,833  
UM, AND THAT'S NOT WHAT  
YOU WANT TO HAPPEN,

447

00:23:34,933 --> 00:23:36,966  
UM, WHEN YOU'RE  
AT 30,000 FEET.

448

00:23:41,300 --> 00:23:44,300

NARRATOR: IN TOTAL, THEY'LL HAVE  
AROUND 32 TONS' WORTH OF HORSES

449

00:23:44,400 --> 00:23:48,233

ON THE FLIGHT, SO IT'S  
CRUCIAL THE CARGO HANDLERS

450

00:23:48,333 --> 00:23:51,100

LOAD UP THE BOXES  
EVENLY THROUGHOUT THE PLANE

451

00:23:51,200 --> 00:23:53,600

TO MAKE SURE  
IT ISN'T UNBALANCED.

452

00:23:57,866 --> 00:23:59,633

AND JUST LIKE US HUMANS,

453

00:23:59,733 --> 00:24:02,300

THE PASSENGERS GET  
WHAT THEY PAY FOR.

454

00:24:02,400 --> 00:24:03,566

YOU CAN HAVE 3  
HORSES IN A BOX,

455

00:24:03,666 --> 00:24:05,133

WHICH IS ECONOMY FLIGHT,

456

00:24:05,233 --> 00:24:06,900

OR ONE OR TWO HORSES  
IN A BOX,

457

00:24:07,000 --> 00:24:08,900

WHICH IS BUSINESS CLASS.

458

00:24:10,833 --> 00:24:15,600

NARRATOR: BY 7 P.M., ALL 64  
HORSES ARE SAFELY ON BOARD.

459

00:24:17,866 --> 00:24:21,133

FLIGHT EK9320 DEPARTS BELGIUM,

460

00:24:21,233 --> 00:24:24,900

EMBARKING ON ITS 6,000-MILE

JOURNEY THROUGH THE NIGHT.

461

00:24:34,600 --> 00:24:37,666  
ITS DESTINATION, HONG KONG,  
IMPORTS AND EXPORTS

462

00:24:37,766 --> 00:24:41,400  
MORE CARGO THAN ANY OTHER  
AIRPORT IN THE WORLD.

463

00:24:41,500 --> 00:24:44,800  
THIS PLACE IS KNOWN  
AS THE GATEWAY TO CHINA

464

00:24:44,900 --> 00:24:48,033  
AND ITS 1.4 BILLION CITIZENS.

465

00:24:53,400 --> 00:24:57,100  
TO KEEP THIS VAST FLOW OF GOODS  
MOVING THROUGH THE SKIES,

466

00:24:57,200 --> 00:25:01,600  
HONG KONG HAS BUILT THE BIGGEST  
CARGO HUB ON THE PLANET.

467

00:25:04,100 --> 00:25:06,066  
[MAN SPEAKING  
FOREIGN LANGUAGE]

468

00:25:06,166 --> 00:25:08,133  
NARRATOR: WHEN THE HORSES  
ARRIVE IN A FEW HOURS,

469

00:25:08,233 --> 00:25:09,166  
THEY WILL BE JOINING

470

00:25:09,266 --> 00:25:11,666  
THE ASTONISHING VARIETY  
OF AIR FREIGHT

471

00:25:11,766 --> 00:25:14,733  
THAT ENDS UP HERE.

472

00:25:14,833 --> 00:25:19,433  
BUT SOME GOODS HAVE TO REACH  
THEIR DESTINATION WITHOUT DELAY.

473

00:25:21,300 --> 00:25:24,866  
THIS IS THE HANDLING ZONE  
FOR PERISHABLE CARGO,

474  
00:25:24,966 --> 00:25:26,333  
THE STUFF THAT MUST  
REACH CUSTOMERS

475  
00:25:26,433 --> 00:25:29,200  
WHILE IT'S STILL FRESH...

476  
00:25:29,300 --> 00:25:31,733  
FROM ALASKAN CRAB

477  
00:25:31,833 --> 00:25:34,533  
TO FLOWERS FROM ECUADOR,

478  
00:25:34,633 --> 00:25:37,633  
SNAILS FROM TAIWAN...

479  
00:25:37,733 --> 00:25:42,466  
AND EXOTIC FRUIT FROM COLOMBIA.

480  
00:25:42,566 --> 00:25:47,366  
WE VERY OFTEN COME ACROSS  
WITH STRANGE THINGS,

481  
00:25:47,466 --> 00:25:52,000  
BUT TO US, IT'S LIKE  
WE'RE ACCUSTOMED TO IT.

482  
00:25:52,100 --> 00:25:56,233  
ALL THE CARGO COMES  
FROM DIFFERENT DIRECTIONS.

483  
00:25:56,333 --> 00:26:01,800  
ALL THE AIRCRAFTS  
PARKED IN THE APRONS  
WAITING TO DEPART--

484  
00:26:01,900 --> 00:26:05,033  
SOMETIMES IT WILL BE  
VERY ODD-SIZED CARGO,

485  
00:26:05,133 --> 00:26:07,000  
UH, WHICH HAS TO  
BE MOVED OUT

486  
00:26:07,100 --> 00:26:09,366  
IN A VERY TIGHT TIME FRAME

487  
00:26:09,466 --> 00:26:12,866  
BEFORE THE DEPARTURE TIME.

488  
00:26:12,966 --> 00:26:15,000  
NARRATOR: DELIVERIES  
OF TIME-CRITICAL CARGO

489  
00:26:15,100 --> 00:26:18,300  
ARE ONLY POSSIBLE  
THANKS TO AVIATION.

490  
00:26:18,400 --> 00:26:21,866  
AIR FREIGHT IS THE ONLY WAY  
TO TRANSPORT IT AROUND THE WORLD

491  
00:26:21,966 --> 00:26:24,633  
FAST ENOUGH.

492  
00:26:24,733 --> 00:26:28,166  
BUT IT'S NOT JUST CRABS,  
SNAILS, AND MYSTERY FRUIT

493  
00:26:28,266 --> 00:26:31,233  
COMING IN AND OUT OF HONK KONG.

494  
00:26:31,333 --> 00:26:34,033  
1 IN EVERY 15 AIR CARGO  
SHIPMENTS

495  
00:26:34,133 --> 00:26:37,633  
TRAVELING AROUND THE GLOBE  
ORIGINATES HERE,

496  
00:26:37,733 --> 00:26:41,966  
AND THIS BUILDING  
IS AT THE EPICENTER.

497  
00:26:42,066 --> 00:26:46,466  
THIS IS SUPER TERMINAL ONE,

498  
00:26:46,566 --> 00:26:50,766  
THE WORLD'S LARGEST  
AIR CARGO TERMINAL...



499

00:26:54,533 --> 00:26:55,500  
ABLE TO PROCESS

500

00:26:55,600 --> 00:26:59,133  
UP TO 3.5 MILLION TONS  
OF AIR FREIGHT A YEAR,

501

00:26:59,233 --> 00:27:02,566  
ARRIVING FROM EVERY PART  
OF THE GLOBE.

502

00:27:06,600 --> 00:27:09,800  
IT'S SORTED AND STORED UNTIL  
READY TO BE SENT OUT AGAIN

503

00:27:09,900 --> 00:27:12,533  
TO ANOTHER PART OF THE WORLD.

504

00:27:13,733 --> 00:27:15,866  
THE CLICK OF YOUR MOUSE  
ON THE "BUY" BUTTON

505

00:27:15,966 --> 00:27:19,533  
DOESN'T ONLY HAVE CONSEQUENCES  
IN THE VIRTUAL WORLD.

506

00:27:19,633 --> 00:27:23,833  
IT SETS IN MOTION GIGANTIC  
CARGO TERMINALS LIKE THIS.

507

00:27:25,600 --> 00:27:27,300  
IT'S EXCITING,  
REALLY EXCITING.

508

00:27:27,400 --> 00:27:31,733  
UH, IT'S LIKE  
THE WORLD IS CHANGING  
ALL THE TIME,

509

00:27:31,833 --> 00:27:33,966  
AND YOU HAVE TO RECEIVE  
ALL THE CHALLENGES

510

00:27:34,066 --> 00:27:35,900  
THAT YOU CANNOT PREDICT.

511

00:27:36,000 --> 00:27:38,233

AND YET WE HAVE TO  
THINK OF THE SOLUTION,

512  
00:27:38,333 --> 00:27:40,400  
HOW YOU CAN MOVE  
THINGS OUT

513  
00:27:40,500 --> 00:27:44,166  
WITHIN THE TIME THAT IS  
REQUIRED BY THE CUSTOMERS.

514  
00:27:47,733 --> 00:27:50,033  
NARRATOR: THE SUPER TERMINAL  
HAS AN INGENIOUS SYSTEM

515  
00:27:50,133 --> 00:27:52,533  
FOR ORGANIZING THE ENORMOUS  
AMOUNT OF CARGO

516  
00:27:52,633 --> 00:27:54,333  
THAT ARRIVES HERE.

517  
00:27:56,666 --> 00:27:59,433  
NONPERISHABLE GOODS ARE FED  
INTO A VAST NETWORK

518  
00:27:59,533 --> 00:28:03,766  
OF ROBOTIC CRATES THAT TRAVEL  
THROUGH MILES OF HIDDEN TUNNELS

519  
00:28:03,866 --> 00:28:07,566  
TO BE STORED ON ONE  
OF 10,000 SHELVES...

520  
00:28:09,400 --> 00:28:13,200  
UNTIL IT'S CALLED UP FOR  
THE NEXT STAGE OF ITS JOURNEY.

521  
00:28:14,733 --> 00:28:16,866  
AND DESPITE  
THE CONSTANT ACTIVITY,

522  
00:28:16,966 --> 00:28:20,166  
THERE'S NOT A SINGLE  
HUMAN AT WORK HERE.

523  
00:28:20,266 --> 00:28:24,666  
THIS IS A VERTICAL CITY

OPERATED BY ROBOTS.

524

00:28:26,666 --> 00:28:28,966  
THE SUPER TERMINAL HAS TO BE  
ABLE TO HANDLE

525

00:28:29,066 --> 00:28:33,000  
EVERY CONCEIVABLE TYPE OF CARGO,

526

00:28:33,100 --> 00:28:37,100  
AND SOME OF THE MOST PRICELESS  
OF ALL IS ABOUT TO LAND.

527

00:28:42,433 --> 00:28:45,033  
THE 64 SHOW JUMPING HORSES  
FROM BELGIUM

528

00:28:45,133 --> 00:28:47,700  
ARE COMING IN RIGHT ON TIME.

529

00:28:58,100 --> 00:29:03,400  
THE SUPER TERMINAL IS USED TO  
DEALING WITH LARGE ANIMALS,

530

00:29:03,500 --> 00:29:05,400  
BUT AFTER 16 HOURS IN THE AIR,

531

00:29:05,500 --> 00:29:08,466  
THE HORSES ARE TIRED  
AND IMPATIENT.

532

00:29:10,833 --> 00:29:13,233  
WITH ONLY TWO DAYS TO GO  
BEFORE THE COMPETITION,

533

00:29:13,333 --> 00:29:15,666  
IT'S CRUCIAL TO GET THEM  
AWAY TO THEIR STABLES

534

00:29:15,766 --> 00:29:19,133  
FOR SOME REST  
AS QUICKLY AS POSSIBLE.

535

00:29:21,766 --> 00:29:24,366  
VET GORDON SIDLOW MADE  
THE JOURNEY ALONGSIDE THEM

536

00:29:24,466 --> 00:29:27,866  
AND NOW HAS TO MAKE SURE  
THEY'RE READY TO COMPETE.

537  
00:29:29,333 --> 00:29:30,300  
SIDLOW: HORSES DO  
GET JET LAG,

538  
00:29:30,400 --> 00:29:31,533  
SOME MORE SO  
THAN OTHERS,

539  
00:29:31,633 --> 00:29:34,033  
UM, BUT IT'S RELATIVELY  
POORLY UNDERSTOOD

540  
00:29:34,133 --> 00:29:35,266  
BECAUSE IT'S MORE  
DIFFICULT TO TELL

541  
00:29:35,366 --> 00:29:38,733  
IF A HORSE IS JET-LAGGED  
OR JUST SIMPLY TIRED.

542  
00:29:38,833 --> 00:29:39,733  
WE WANT TO MAKE SURE

543  
00:29:39,833 --> 00:29:41,000  
WHEN THE HORSES  
GET IN THE STABLES

544  
00:29:41,100 --> 00:29:43,733  
THEY ALL START EATING  
AND DRINKING STRAIGHTAWAY.

545  
00:29:43,833 --> 00:29:45,533  
DEHYDRATION  
AND TRAVEL SICKNESS

546  
00:29:45,633 --> 00:29:47,333  
ARE THE MAIN THINGS  
WE'RE LOOKING FOR,

547  
00:29:47,433 --> 00:29:48,633  
AND THE SIGN OF THAT

548  
00:29:48,733 --> 00:29:50,466  
IS A HORSE THAT

ISN'T EATING,  
ISN'T DRINKING,

549  
00:29:50,566 --> 00:29:52,066  
AND LOOKING MISERABLE.

550  
00:29:54,400 --> 00:29:56,366  
NARRATOR: IN TWO HOURS FLAT, EVERY LAST HORSE

551  
00:29:56,466 --> 00:29:59,066  
HAS BEEN WHISKED AWAY  
TO ITS STABLE.

552  
00:30:01,133 --> 00:30:02,400  
SIDLOW: THEY GET  
A DAY OFF TOMORROW,

553  
00:30:02,500 --> 00:30:04,633  
AND AFTER THAT,  
IT'S--IT'S BACK TO WORK,

554  
00:30:04,733 --> 00:30:07,100  
SO, UM, IT'S--IT'S  
NOT AN EASY LIFE FOR THEM.

555  
00:30:07,200 --> 00:30:10,333  
IT'S, UH--IT'S A TOUGH--  
IT'S A TOUGH GAME.

556  
00:30:14,366 --> 00:30:17,333  
NARRATOR: WHETHER  
IT'S HORSES, FRUIT, OR YOU,

557  
00:30:17,433 --> 00:30:19,300  
EVERYTHING TRANSPORTED BY AIR

558  
00:30:19,400 --> 00:30:22,400  
HAS TO REACH  
ITS DESTINATION SAFELY.

559  
00:30:23,800 --> 00:30:25,300  
TO MAKE SURE OF THAT,

560  
00:30:25,400 --> 00:30:26,833  
A PLANE HAS TO SURVIVE

561  
00:30:26,933 --> 00:30:30,566

EXTRAORDINARILY PUNISHING  
STRESSES AND STRAINS.

562  
00:30:35,033 --> 00:30:40,200  
IT'S NO MEAN FEAT TO KEEP 92,000  
POUNDS OF AIRPLANE ALOFT,

563  
00:30:40,300 --> 00:30:42,766  
NOT TO MENTION ANOTHER  
59,000 POUNDS

564  
00:30:42,866 --> 00:30:47,000  
OF PASSENGERS, FUEL, AND CARGO.

565  
00:30:47,100 --> 00:30:51,200  
SO HOW DOES A JET WITH WALLS  
ONLY A FRACTION OF AN INCH THIN

566  
00:30:51,300 --> 00:30:55,266  
COPE WITH THE EXTREME FORCES  
IT ENCOUNTERS IN THE SKY?

567  
00:30:58,666 --> 00:31:03,633  
PARTLY IT'S DOWN TO THE  
MATERIALS OF WHICH IT'S MADE,

568  
00:31:03,733 --> 00:31:04,900  
AND IF YOU'RE TRAVELING  
ON A PLANE

569  
00:31:05,000 --> 00:31:07,933  
MANUFACTURED IN  
THE LAST FEW YEARS,

570  
00:31:08,033 --> 00:31:13,733  
IT MIGHT BE BUILT LARGELY OF  
A RADICAL NEW KIND OF MATERIAL,

571  
00:31:13,833 --> 00:31:18,900  
A MATERIAL WITH SOME  
EXTRAORDINARY PROPERTIES.

572  
00:31:19,000 --> 00:31:21,466  
IT'S LED TO THE BIGGEST CHANGE  
IN AVIATION DESIGN

573  
00:31:21,566 --> 00:31:26,166  
SINCE ALUMINUM REPLACED

WOODEN PLANES BACK IN THE 1920s.

574

00:31:27,666 --> 00:31:29,600

AND IT'S ENABLING  
THE CONSTRUCTION

575

00:31:29,700 --> 00:31:32,766

OF A NEW GENERATION OF JETS.

576

00:31:32,866 --> 00:31:39,333

ONE OF THE FIRST WAS THE BOEING  
787, AKA THE DREAMLINER.

577

00:31:41,233 --> 00:31:44,433

WITH THIS AIRCRAFT,  
IT'S NOT ABOUT THE SIZE.

578

00:31:44,533 --> 00:31:46,700

IT'S ALL ABOUT THE WEIGHT.

579

00:31:48,433 --> 00:31:52,800

AND THE MATERIAL THAT'S MADE IT  
POSSIBLE IS CARBON COMPOSITE,

580

00:31:52,900 --> 00:31:57,433

AN INGENIOUS BLEND OF CARBON FIBER AND PLASTIC.

581

00:31:57,533 --> 00:32:01,233

KIM PASTEGA IS RESPONSIBLE  
FOR DREAMLINER PRODUCTION

582

00:32:01,333 --> 00:32:04,333

AND KNOWS WHAT A REVOLUTION  
IT REPRESENTS.

583

00:32:04,433 --> 00:32:05,466

WELL, I'VE GOT A PIECE

584

00:32:05,566 --> 00:32:06,566

OF ALUMINUM HERE,

585

00:32:06,666 --> 00:32:07,566

WHICH IS, OF COURSE,

586

00:32:07,666 --> 00:32:08,566

WHAT WE TRADITIONALLY

587  
00:32:08,666 --> 00:32:09,600  
HAVE MANUFACTURED

588  
00:32:09,700 --> 00:32:10,833  
AIRPLANES WITH,

589  
00:32:10,933 --> 00:32:12,133  
AND A PIECE OF OUR

590  
00:32:12,233 --> 00:32:14,066  
COMPOSITE STRUCTURE HERE.

591  
00:32:14,166 --> 00:32:16,400  
WELL, FIRST OF ALL,  
ONE OF THE HUGE DIFFERENCES

592  
00:32:16,500 --> 00:32:18,300  
YOU'D BE ABLE TO FEEL  
IF YOU WERE HOLDING THEM

593  
00:32:18,400 --> 00:32:21,600  
IS JUST THE WEIGHT  
BETWEEN THE TWO.

594  
00:32:21,700 --> 00:32:24,033  
IT'S A MASSIVE DIFFERENCE  
IN TERMS OF

595  
00:32:24,133 --> 00:32:26,333  
HOW THE AIRPLANE  
PERFORMS WITH FUEL.

596  
00:32:26,433 --> 00:32:28,500  
UM, MAYBE TO GIVE YOU  
SOME IDEA,

597  
00:32:28,600 --> 00:32:32,100  
UH, WE'VE GOT NOW OVER 300  
AIRPLANES FLYING IN SERVICE.

598  
00:32:32,200 --> 00:32:34,700  
WE'VE BEEN IN SERVICE  
SINCE THE END OF 2011,

599  
00:32:34,800 --> 00:32:38,866  
AND IN JUST THOSE SHORT,  
YOU KNOW, 3 1/2, 4 YEARS,



600

00:32:38,966 --> 00:32:42,666

WE'VE ALREADY SAVED  
OVER 5 BILLION POUNDS  
OF FUEL

601

00:32:42,766 --> 00:32:45,033

WITH OUR 787 FLEET.

602

00:32:45,133 --> 00:32:48,066

THAT'S 20% TO 25%  
MORE FUEL-EFFICIENT

603

00:32:48,166 --> 00:32:50,300

THAN THE AIRPLANES  
THAT IT'S REPLACING.

604

00:32:53,466 --> 00:32:56,833

NARRATOR: BUT LIGHTER COMPOSITES  
DON'T JUST SAVE FUEL.

605

00:32:56,933 --> 00:33:02,833

THEY ALSO GIVE THE AIRCRAFT  
SOME ENTIRELY NEW PROPERTIES.

606

00:33:02,933 --> 00:33:05,900

AT MANCHESTER UNIVERSITY'S  
COMPOSITES TESTING FACILITY

607

00:33:06,000 --> 00:33:09,000

IN THE UNITED KINGDOM,  
PROFESSOR ANDREW WALKER

608

00:33:09,100 --> 00:33:12,933

IS PUSHING THE BOUNDARIES  
OF THIS EXTRAORDINARY MATERIAL.

609

00:33:16,633 --> 00:33:19,133

TO BEGIN TO UNDERSTAND  
ITS STRANGE PROPERTIES,

610

00:33:19,233 --> 00:33:22,366

FIRST YOU NEED TO KNOW  
HOW IT'S MADE.

611

00:33:27,733 --> 00:33:31,133

AT FACILITIES LIKE THIS,  
CARBON FIBERS ARE WOVEN

612

00:33:31,233 --> 00:33:34,266  
INTO LAYERS ALMOST  
LIKE A FABRIC,

613

00:33:34,366 --> 00:33:37,300  
WHICH THEN GETS HARDENED  
WITH PLASTIC RESIN.

614

00:33:39,933 --> 00:33:43,900  
IT'S BEYOND DOUBT THAT IT'S  
LIGHTER THAN ALUMINUM.

615

00:33:44,000 --> 00:33:45,866  
BUT CAN A PLANE  
MADE OF COMPOSITE

616

00:33:45,966 --> 00:33:49,766  
REALLY BE AS STRONG  
AS ONE MADE OF METAL?

617

00:33:54,233 --> 00:33:57,533  
TO PUT IT TO THE TEST,  
PROFESSOR WALKER IS USING

618

00:33:57,633 --> 00:34:01,000  
AN INSTRON MACHINE,  
A DEVICE THAT MEASURES

619

00:34:01,100 --> 00:34:03,733  
A MATERIAL'S BREAKING POINT.

620

00:34:03,833 --> 00:34:05,700  
FIRST UP, THE ALUMINUM.

621

00:34:05,800 --> 00:34:06,900  
YOU CAN'T SEE  
THE MACHINE MOVING,

622

00:34:07,000 --> 00:34:10,000  
BUT THE TWO PLATENS ARE  
ACTUALLY MOVING APART

623

00:34:10,100 --> 00:34:11,900  
VERY SLOWLY NOW.

624

00:34:12,000 --> 00:34:16,033

IT'S ABOUT 650 KILOGRAMS.

625

00:34:16,133 --> 00:34:21,199

THAT'S ABOUT, UH, 6 OR 7  
PEOPLE OR A SMALL MOTORCAR.

626

00:34:21,300 --> 00:34:23,166

THE STRETCH AT THE MOMENT,  
IT'S ABOUT 6 MILLIMETERS--

627

00:34:23,266 --> 00:34:25,366

WE CAN SEE THIS  
ON THE COMPUTER--

628

00:34:25,466 --> 00:34:30,133

AND THE LOAD APPLIED  
IS ABOUT 700 KILOGRAMS.

629

00:34:30,233 --> 00:34:32,333

AND WE SHOULD SEE IT  
BEGIN TO FAIL.

630

00:34:35,100 --> 00:34:37,866

THERE WE GO.

631

00:34:37,966 --> 00:34:38,866

NARRATOR: WHEN LOADED  
WITH THE WEIGHT

632

00:34:38,966 --> 00:34:41,500

OF AROUND ONE AND A HALF  
THOUSAND POUNDS,

633

00:34:41,600 --> 00:34:45,100

THE ALUMINUM STRETCHES  
AROUND 1/4 OF AN INCH

634

00:34:45,199 --> 00:34:46,766

BEFORE SNAPPING.

635

00:34:49,600 --> 00:34:52,966

NOW FOR THE CARBON COMPOSITE.

636

00:34:53,066 --> 00:34:54,233

WALKER: YOU CAN HEAR PINGS,

637

00:34:54,333 --> 00:34:59,266

AND THOSE ARE CARBON FIBERS  
BREAKING IN THE SAMPLE.

638

00:34:59,366 --> 00:35:03,200  
IT'S ABOUT 7 TIMES THE FAILURE  
LOAD OF THE ALUMINUM.

639

00:35:06,500 --> 00:35:08,500  
NARRATOR: NOT ONLY  
IS THE COMPOSITE MATERIAL

640

00:35:08,600 --> 00:35:11,366  
ABLE TO RESIST  
A FAR GREATER FORCE,

641

00:35:11,466 --> 00:35:14,333  
IT'S HARDLY STRETCHING AT ALL.

642

00:35:14,433 --> 00:35:16,700  
IT'S NOW SUPPORTING  
10 TIMES THE WEIGHT

643

00:35:16,800 --> 00:35:20,666  
THAT TOOK THE ALUMINUM  
TO ITS BREAKING POINT.

644

00:35:20,766 --> 00:35:21,933  
WALKER: THERE WE ARE.

645

00:35:23,633 --> 00:35:24,633  
NARRATOR: WHERE  
THE ALUMINUM BROKE

646

00:35:24,733 --> 00:35:27,166  
WHEN LOADED WITH THE WEIGHT  
OF 10 PEOPLE,

647

00:35:27,266 --> 00:35:32,566  
THE CARBON COMPOSITE CAN TAKE  
THE WEIGHT OF A SCHOOL BUS.

648

00:35:32,666 --> 00:35:35,266  
SIGNIFICANTLY STRONGER  
AND STIFFER

649

00:35:35,366 --> 00:35:37,433  
THAN EXISTING  
ALUMINUM ALLOYS.

650  
00:35:39,733 --> 00:35:41,966  
NARRATOR: THE STRENGTH  
AND STIFFNESS OF COMPOSITES

651  
00:35:42,066 --> 00:35:45,733  
HAVE RADICALLY CHANGED  
HOW AIRCRAFT ARE DESIGNED,

652  
00:35:45,833 --> 00:35:48,866  
IN SOME UNEXPECTED WAYS.

653  
00:35:48,966 --> 00:35:51,133  
WHEN COMPOSITES FIRST  
BECAME AVAILABLE,

654  
00:35:51,233 --> 00:35:54,333  
BOEING SOUGHT TO TAKE ADVANTAGE  
OF THEIR UNIQUE PROPERTIES

655  
00:35:54,433 --> 00:35:57,066  
TO TRANSFORM  
THE PASSENGER EXPERIENCE,

656  
00:35:57,166 --> 00:36:00,800  
A CHALLENGE PASSED DOWN TO  
AIRPLANE INTERIORS DESIGN GURU

657  
00:36:00,900 --> 00:36:02,533  
BLAKE EMERY.

658  
00:36:02,633 --> 00:36:04,466  
EMERY: SO, WHAT WE'RE SEEING  
HERE IS WHAT WE CALL

659  
00:36:04,566 --> 00:36:07,166  
OUR--OUR FULL DOME AT ENTRY.

660  
00:36:07,266 --> 00:36:10,333  
IT REALLY PROVIDES  
AN INCREDIBLE TRANSITION

661  
00:36:10,433 --> 00:36:11,566  
BETWEEN THE JETWAY,

662  
00:36:11,666 --> 00:36:14,666  
WHICH CAN KIND OF

COMPRESS YOU PSYCHOLOGICALLY,

663

00:36:14,766 --> 00:36:17,700

TO THIS: THIS SENSATION  
OF NOTHING ABOVE YOU,

664

00:36:17,800 --> 00:36:22,500

SO IT REALLY KIND OF PROVIDES  
A PSYCHOLOGICAL RELIEF.

665

00:36:24,666 --> 00:36:26,800

NARRATOR: INTERIOR DESIGN  
IS ONE THING,

666

00:36:26,900 --> 00:36:29,766

BUT THERE'S SOMETHING INVISIBLE  
THAT HAS A BIGGER IMPACT

667

00:36:29,866 --> 00:36:34,300

ON PASSENGERS: THE UNPLEASANT  
FEELING WE LOOSELY REFER TO

668

00:36:34,400 --> 00:36:36,533

AS JET LAG.

669

00:36:38,466 --> 00:36:41,100

AND SOME OF THE SENSATIONS  
WE ASSOCIATE WITH IT

670

00:36:41,200 --> 00:36:44,833

COULD BE DUE TO NOT HAVING  
QUITE ENOUGH OXYGEN TO BREATHE

671

00:36:44,933 --> 00:36:47,266

WHEN WE'RE IN FLIGHT.

672

00:36:50,100 --> 00:36:53,200

OUTSIDE THE WINDOW OF A PLANE  
AT 30,000 FEET,

673

00:36:53,300 --> 00:36:56,300

THE AIR IS SO THIN,  
IF YOU WERE EXPOSED TO IT,

674

00:36:56,400 --> 00:37:00,700

YOU WOULD BECOME  
UNCONSCIOUS IN SECONDS.

675

00:37:00,800 --> 00:37:03,500

SO TO STOP US DYING  
FROM LACK OF OXYGEN,

676

00:37:03,600 --> 00:37:06,700

AIRPLANE CABINS ARE PUMPED  
FULL OF AIR.

677

00:37:08,533 --> 00:37:13,233

BUT IT'S CONSIDERABLY LESS AIR  
THAN AT GROUND LEVEL.

678

00:37:13,333 --> 00:37:19,000

THERE'S A VERY GOOD REASON  
WHY MORE AIR CAN'T BE PUMPED IN.

679

00:37:19,100 --> 00:37:21,233

EVERY TIME THE CABIN  
IS PRESSURIZED,

680

00:37:21,333 --> 00:37:23,600

THE ALUMINUM HULL OF  
A TRADITIONAL PLANE

681

00:37:23,700 --> 00:37:27,466

STRETCHES A TINY BIT...

682

00:37:27,566 --> 00:37:32,033

PULLING AGAINST  
RIVETS AND JOINS.

683

00:37:32,133 --> 00:37:34,466

SO TO REDUCE STRAIN  
ON THE FUSELAGE,

684

00:37:34,566 --> 00:37:36,000

MOST PLANES ARE PUMPED UP

685

00:37:36,100 --> 00:37:38,166

WITH THE MINIMUM AMOUNT  
OF AIR REQUIRED

686

00:37:38,266 --> 00:37:40,000

TO KEEP US COMFORTABLE.

687

00:37:42,600 --> 00:37:45,800

BUT COMPOSITE PLANES

HARDLY STRETCH AT ALL,

688

00:37:45,900 --> 00:37:50,666  
SO YOU CAN PUMP IN MORE AIR  
WITHOUT DAMAGING THEM.

689

00:37:50,766 --> 00:37:53,933  
SOME RESEARCH NOW SUGGESTS  
THAT HAVING MORE AIR TO BREATHE

690

00:37:54,033 --> 00:38:00,200  
MIGHT REDUCE SOME SYMPTOMS  
WE ASSOCIATE WITH JET LAG.

691

00:38:00,300 --> 00:38:01,933  
EMERY: WHAT WE DISCOVERED IS,

692

00:38:02,033 --> 00:38:07,300  
MUCH FEWER SYMPTOMS AND FEWER  
PEOPLE EXPERIENCING SYMPTOMS

693

00:38:07,400 --> 00:38:11,033  
ON THE DREAMLINER  
THAN ON OTHER AIRPLANES.

694

00:38:11,133 --> 00:38:15,833  
IF YOU ARE A PASSENGER  
THAT EXPERIENCES

695

00:38:15,933 --> 00:38:19,166  
THE SYMPTOMS ASSOCIATED  
WITH HIGH ALTITUDE,

696

00:38:19,266 --> 00:38:22,566  
YOU EITHER ARE NOT GOING TO HAVE  
THOSE SYMPTOMS AT ALL,

697

00:38:22,666 --> 00:38:24,133  
OR IF YOU DO HAVE  
THOSE SYMPTOMS,

698

00:38:24,233 --> 00:38:26,933  
THEY'RE GOING TO BE  
MUCH LESS SEVERE--

699

00:38:27,033 --> 00:38:29,200  
SYMPTOMS LIKE HEADACHE,  
MUSCLE ACHE.



700  
00:38:29,300 --> 00:38:31,400  
SOME PEOPLE EXPERIENCE  
A--A COLDNESS

701  
00:38:31,500 --> 00:38:33,266  
IN THEIR FINGERTIPS  
OR THEIR FEET.

702  
00:38:33,366 --> 00:38:34,666  
THINGS LIKE THAT.

703  
00:38:37,966 --> 00:38:40,766  
NARRATOR: THE JURY'S STILL OUT  
ON EXACTLY HOW AIR PRESSURE

704  
00:38:40,866 --> 00:38:45,600  
AFFECTS JET LAG, BUT THANKS TO  
THE SHIFT TO COMPOSITE PLANES,

705  
00:38:45,700 --> 00:38:48,700  
FEELING ROUGH AFTER A LONG  
FLIGHT COULD SOON BE

706  
00:38:48,800 --> 00:38:50,733  
A THING OF THE PAST.

707  
00:38:53,700 --> 00:38:55,000  
IT MAY NOW BE POSSIBLE

708  
00:38:55,100 --> 00:38:58,466  
TO KEEP PASSENGERS  
COMFORTABLE IN THE AIR.

709  
00:38:58,566 --> 00:39:02,533  
BUT WITH 100,000 FLIGHTS  
CROSSING OUR SKIES EVERY DAY,

710  
00:39:02,633 --> 00:39:06,466  
ENSURING THE PHYSICAL WELL-BEING  
OF THE AIRCRAFT THEMSELVES

711  
00:39:06,566 --> 00:39:10,100  
REMAINS A HUGE CHALLENGE.

712  
00:39:10,200 --> 00:39:12,000  
[THUNDER]

713  
00:39:12,100 --> 00:39:17,533  
EVERY DAY, PLANES ENTER THE MOST  
HOSTILE ENVIRONMENT IMAGINABLE.

714  
00:39:17,633 --> 00:39:19,766  
FLYING HIGHER  
THAN MOUNT EVEREST,

715  
00:39:19,866 --> 00:39:22,600  
BATTERED BY WINDS OF  
HUNDREDS OF MILES AN HOUR,

716  
00:39:22,700 --> 00:39:25,233  
WE JUST EXPECT THEM  
TO FUNCTION PERFECTLY,

717  
00:39:25,333 --> 00:39:27,266  
FLIGHT AFTER FLIGHT.

718  
00:39:27,366 --> 00:39:30,566  
BUT AS THEY RACK UP AIR MILES,  
THERE'S ONE EXTREME HAZARD

719  
00:39:30,666 --> 00:39:34,366  
ALL AIRCRAFT WILL  
INVARIABLY RUN INTO...

720  
00:39:34,466 --> 00:39:37,500  
[THUNDER]

721  
00:39:37,600 --> 00:39:40,566  
LIGHTNING...

722  
00:39:40,666 --> 00:39:43,933  
BY FAR THE MOST DANGEROUS,  
POWERFUL FORCE OF NATURE

723  
00:39:44,033 --> 00:39:46,633  
YOUR PLANE IS EVER  
LIKELY TO ENCOUNTER.

724  
00:39:48,400 --> 00:39:50,333  
DOWN ON THE GROUND,  
GETTING STRUCK BY LIGHTNING

725  
00:39:50,433 --> 00:39:52,666

IS A RARE EVENT.

726

00:39:52,766 --> 00:39:55,433  
NOT SO UP IN THE AIR.

727

00:39:57,566 --> 00:40:00,700  
IN FACT, EVERY PLANE GETS  
STRUCK BY LIGHTNING

728

00:40:00,800 --> 00:40:03,466  
ONCE A YEAR ON AVERAGE.

729

00:40:03,566 --> 00:40:06,233  
THAT MEANS ACROSS A TYPICAL  
JET'S LIFETIME,

730

00:40:06,333 --> 00:40:11,033  
IT'LL GET ZAPPED  
AN ASTONISHING 25 TIMES.

731

00:40:15,366 --> 00:40:16,966  
SO WHY AREN'T PASSENGERS

732

00:40:17,066 --> 00:40:20,733  
REGULARLY GETTING  
ELECTROCUTED IN FLIGHT?

733

00:40:20,833 --> 00:40:23,800  
IT'S THANKS IN PART TO THE KIND  
OF RESEARCH THEY DO HERE

734

00:40:23,900 --> 00:40:26,033  
IN DARMSTADT, GERMANY.

735

00:40:29,100 --> 00:40:31,033  
[SPEAKS GERMAN]

736

00:40:31,133 --> 00:40:34,133  
AT DARMSTADT UNIVERSITY'S  
HIGH VOLTAGE LAB,

737

00:40:34,233 --> 00:40:36,266  
PROFESSOR VOLKER HINRICHSSEN  
AND HIS TEAM

738

00:40:36,366 --> 00:40:38,633  
STUDY LIGHTNING PROTECTION.

739  
00:40:41,533 --> 00:40:45,233  
A CAR OFFERS YOU MUCH THE SAME  
PROTECTION AS A PLANE.

740  
00:40:45,333 --> 00:40:49,200  
THEY'RE BOTH METAL BOXES  
WITH PEOPLE INSIDE.

741  
00:40:53,266 --> 00:40:56,233  
THE LAB'S LIGHTNING GENERATOR  
IS DESIGNED TO BUILD UP

742  
00:40:56,333 --> 00:40:59,300  
ENOUGH ELECTRICAL CHARGE  
TO FIRE A TWO MILLION VOLT

743  
00:40:59,400 --> 00:41:01,400  
BOLT OF ELECTRICITY.

744  
00:41:02,766 --> 00:41:07,433  
THAT'S A SMALL BUT VERY  
REALISTIC LIGHTNING STRIKE...

745  
00:41:07,533 --> 00:41:09,033  
MORE THAN ENOUGH ELECTRICITY

746  
00:41:09,133 --> 00:41:11,900  
TO TURN VOLKER  
INTO A SMOKING HEAP.

747  
00:41:12,000 --> 00:41:14,100  
HINRICHSSEN: SO I HAVE  
JUST TO WAIT.

748  
00:41:14,200 --> 00:41:16,300  
THEY ARE CHARGING  
THE GENERATOR NOW,

749  
00:41:16,400 --> 00:41:20,133  
AND VERY SUDDENLY,  
IT WILL BE DISCHARGED.

750  
00:41:20,233 --> 00:41:24,433  
MAN: FUNF, VIER,  
DREI, ZWEI, EINS,

751

00:41:24,533 --> 00:41:25,866  
SCHUSS.

752  
00:41:25,966 --> 00:41:28,233  
WOW. THAT WAS--HA!

753  
00:41:28,333 --> 00:41:29,700  
SO WE HAVE NOW THE DISCHARGE,

754  
00:41:29,800 --> 00:41:31,533  
AND YOU SEE,  
NOTHING HAPPENED TO ME.

755  
00:41:31,633 --> 00:41:33,666  
IT'S ABSOLUTELY  
SAFE IN THE CAR.

756  
00:41:33,766 --> 00:41:34,900  
SCHUSS.

757  
00:41:33,766 --> 00:41:34,900  
[CRACK OF ELECTRICITY]

758  
00:41:35,000 --> 00:41:36,066  
SCHUSS.

759  
00:41:36,166 --> 00:41:38,133  
YOU SEE I AM STILL ALIVE.

760  
00:41:40,966 --> 00:41:44,566  
NARRATOR: A SINGLE BOLT IS TOO  
QUICK TO SEE IN DETAIL,

761  
00:41:44,666 --> 00:41:47,500  
BUT THE LAB CAN GENERATE  
A SLOWER ELECTRIC PULSE

762  
00:41:47,600 --> 00:41:49,000  
TO HELP SHOW WHAT HAPPENS

763  
00:41:49,100 --> 00:41:51,833  
WHEN LIGHTNING HITS  
A METAL ENCLOSURE.

764  
00:41:54,133 --> 00:41:55,900  
THIS CAR MAY BE ON THE GROUND,

765  
00:41:56,000 --> 00:41:58,966  
BUT ELECTRICITY FLOWS  
THROUGH A PLANE IN THE AIR

766  
00:41:59,066 --> 00:42:01,133  
IN A VERY SIMILAR WAY.

767  
00:42:04,566 --> 00:42:05,833  
HINRICHSSEN: IT'S A QUITE  
SIMPLE PRINCIPLE

768  
00:42:05,933 --> 00:42:07,366  
IN ELECTRICAL ENGINEERING.

769  
00:42:07,466 --> 00:42:10,866  
SO THIS--THAT IS WHAT WE  
NAME THE FARADAY CAGE.

770  
00:42:10,966 --> 00:42:13,666  
THAT MEANS THE STRIKE  
TERMINATES ON THE CAR,

771  
00:42:13,766 --> 00:42:16,000  
UH, IT DISCHARGES ON THE CAR,

772  
00:42:16,100 --> 00:42:19,533  
THE CHARGE FLOWS OVER THE  
METALLIC SURFACE OF THE CAR,

773  
00:42:19,633 --> 00:42:21,833  
BYPASSES ME, DOESN'T  
FLOW THROUGH MY BODY,

774  
00:42:21,933 --> 00:42:24,833  
AND THAT IS WHY I AM  
SURVIVING THAT.

775  
00:42:24,933 --> 00:42:26,466  
NARRATOR: IT'S THANKS TO  
THE FARADAY EFFECT

776  
00:42:26,566 --> 00:42:27,666  
THAT WE ARE KEPT SAFE

777  
00:42:27,766 --> 00:42:30,466  
WHEN A METAL PLANE GETS  
STRUCK BY LIGHTNING.

778

00:42:30,566 --> 00:42:32,400  
[CRACK OF ELECTRICITY]

779

00:42:33,966 --> 00:42:34,933  
THAT'S ALL VERY WELL

780

00:42:35,033 --> 00:42:37,966  
FOR PASSENGER PLANES  
STILL MADE OF METAL,

781

00:42:38,066 --> 00:42:42,200  
BUT IT POSES A PROBLEM FOR THE  
NEW BREED OF COMPOSITE AIRCRAFT.

782

00:42:44,766 --> 00:42:46,733  
COMPOSITE DOESN'T  
DISPERSE ELECTRICITY

783

00:42:46,833 --> 00:42:50,100  
IN THE SAME WAY AS METAL,  
SO WITHOUT PROTECTION,

784

00:42:50,200 --> 00:42:51,866  
THESE PLANES  
AND THEIR PASSENGERS

785

00:42:51,966 --> 00:42:54,766  
WOULD BE IN REAL DANGER.

786

00:42:58,300 --> 00:43:02,300  
HERE IN A NONDESCRIPT INDUSTRIAL  
ZONE IN SOUTH WALES,

787

00:43:02,400 --> 00:43:03,933  
A RESEARCH TEAM IS STUDYING

788

00:43:04,033 --> 00:43:08,700  
HOW COMPOSITE PLANES ARE  
AFFECTED BY LIGHTNING.

789

00:43:08,800 --> 00:43:10,333  
TO HELP ILLUSTRATE WHAT HAPPENS

790

00:43:10,433 --> 00:43:12,233  
WHEN A NONMETALLIC  
PLANE COMPONENT

791  
00:43:12,333 --> 00:43:14,700  
FAILS TO DISPERSE  
A LIGHTNING STRIKE,

792  
00:43:14,800 --> 00:43:17,700  
THEY'VE OFFERED TO DEMONSTRATE  
ON THIS RATHER CHARMING

793  
00:43:17,800 --> 00:43:20,233  
NONMETALLIC GARDEN ORNAMENT.

794  
00:43:22,633 --> 00:43:24,833  
THE ONLY WAY TO CAPTURE  
THE MOMENT OF IMPACT

795  
00:43:24,933 --> 00:43:28,300  
IS BY USING  
AN ULTRA-HIGH-SPEED CAMERA

796  
00:43:28,400 --> 00:43:31,633  
INSULATED IN A BLAST-PROOF BOX.

797  
00:43:33,300 --> 00:43:35,800  
[BEEPING]

798  
00:43:55,200 --> 00:43:57,966  
THE GNOME DIDN'T FARE TOO WELL.

799  
00:43:58,066 --> 00:44:00,700  
IT'S THE JOB OF  
PROFESSOR MANU HADDAD

800  
00:44:00,800 --> 00:44:03,466  
TO MAKE SURE THE DESTRUCTIVE  
POWER OF LIGHTNING

801  
00:44:03,566 --> 00:44:07,066  
NEVER HAS THIS IMPACT  
ON A PLANE,

802  
00:44:07,166 --> 00:44:11,266  
AND NONMETALLIC COMPOSITE PARTS  
GAVE HIM A REAL HEADACHE.

803  
00:44:11,366 --> 00:44:12,766  
HADDAD: THE REASON WHY



WE DO THIS RESEARCH

804

00:44:12,866 --> 00:44:14,166

IS THAT YOU NEED TO  
MAKE SURE

805

00:44:14,266 --> 00:44:17,066

THAT ANY MATERIAL THAT  
YOU USE IN AIRCRAFT

806

00:44:17,166 --> 00:44:20,166

IS ACTUALLY SAFE WHEN  
IT'S HIT BY LIGHTNING.

807

00:44:20,266 --> 00:44:23,633

IF, UM, THERE WAS NO  
LIGHTNING PROTECTION  
DESIGN,

808

00:44:23,733 --> 00:44:26,966

YOU WOULD HAVE  
A VERY DISASTROUS  
EFFECT, UM,

809

00:44:27,066 --> 00:44:29,333

DUE TO A LIGHTNING  
STRIKE.

810

00:44:32,100 --> 00:44:34,933

NARRATOR: SO, WHAT HAPPENS  
TO UNPROTECTED COMPOSITE

811

00:44:35,033 --> 00:44:38,000

WHEN IT'S ZAPPED BY AN  
ARTIFICIAL LIGHTNING BOLT?

812

00:44:38,100 --> 00:44:40,333

3, 2, 1.

813

00:44:48,900 --> 00:44:51,266

NARRATOR: WHEN THIS ORDINARY CARBON COMPOSITE

814

00:44:51,366 --> 00:44:54,100

IS HIT BY LIGHTNING,  
STRIPS OF CARBON FIBER

815

00:44:54,200 --> 00:44:57,433

ARE BLASTED OFF THE SURFACE.

816  
00:44:57,533 --> 00:44:59,166  
YOU REALLY WOULDN'T WANT  
THAT TO HAPPEN

817  
00:44:59,266 --> 00:45:04,866  
TO YOUR AIRCRAFT'S HULL  
AT 10,000 FEET.

818  
00:45:04,966 --> 00:45:07,933  
IT WAS A HUGE CHALLENGE  
TO FIND A WAY OF PROTECTING

819  
00:45:08,033 --> 00:45:13,400  
THE NEW GENERATION OF COMPOSITE  
PLANES FROM THIS TYPE OF DAMAGE.

820  
00:45:13,500 --> 00:45:17,533  
AFTER DECADES WITH NO LARGE JETS  
LOST TO LIGHTNING STRIKES,

821  
00:45:17,633 --> 00:45:20,966  
NOBODY WANTED TO SEE  
THIS THREAT RE-EMERGE.

822  
00:45:22,633 --> 00:45:27,466  
SO ENGINEERS CAME UP WITH  
A BRILLIANTLY SIMPLE PLAN.

823  
00:45:27,566 --> 00:45:30,000  
HADDAD: FORTUNATELY WE  
HAVE A VERY GOOD SOLUTION,

824  
00:45:30,100 --> 00:45:31,933  
AND THIS IS USING  
A COPPER MESH,

825  
00:45:32,033 --> 00:45:35,066  
A VERY THIN COPPER MESH,  
THAT YOU WOULD PUT

826  
00:45:35,166 --> 00:45:38,033  
ON TOP OF THE CARBON  
COMPOSITE,

827  
00:45:38,133 --> 00:45:41,000  
AND THAT WILL ALLOW, THEN,  
THE DISTRIBUTION OF THE CURRENT

828  
00:45:41,100 --> 00:45:42,700  
UNIFORMLY ON THE SURFACE

829  
00:45:42,800 --> 00:45:45,600  
AND AVOID THE DAMAGE  
THAT YOU SEE HERE.

830  
00:45:48,400 --> 00:45:53,066  
AND THIS IS THE PROTECTED SIDE,  
WHICH HAS THE MESH.

831  
00:45:53,166 --> 00:45:54,766  
NARRATOR: THE DELICATE LAYER  
OF COPPER WEBBING

832  
00:45:54,866 --> 00:45:56,600  
EMBEDDED ON THE OTHER  
SIDE OF THE PLATE

833  
00:45:56,700 --> 00:46:01,066  
SHOULD, IN THEORY, PROTECT  
A COMPOSITE PLANE.

834  
00:46:07,600 --> 00:46:09,733  
HADDAD: AS YOU CAN SEE,  
THERE IS VERY LITTLE DAMAGE

835  
00:46:09,833 --> 00:46:12,366  
ON THE SURFACE OF  
THE PANEL THIS TIME.

836  
00:46:12,466 --> 00:46:17,500  
UH, WHAT THE PROTECTION, OR  
THE MESH THAT WE PUT HERE, DID--

837  
00:46:17,600 --> 00:46:20,000  
IT GUARANTEED THAT THE CURRENT

838  
00:46:20,100 --> 00:46:22,466  
IS ACTUALLY  
DISTRIBUTED UNIFORMLY,

839  
00:46:22,566 --> 00:46:25,866  
AND AS YOU CAN SEE, THIS IS  
A VERY GOOD DEMONSTRATION

840

00:46:25,966 --> 00:46:30,033  
ON HOW LIGHTNING PROTECTION  
OF CARBON COMPOSITES WORKS.

841  
00:46:30,133 --> 00:46:32,666  
NARRATOR: SO EVERY NEW PLANE  
MADE WITH CARBON COMPOSITE

842  
00:46:32,766 --> 00:46:34,433  
NOW ROLLS OFF THE ASSEMBLY LINE

843  
00:46:34,533 --> 00:46:36,400  
WITH A FINE  
PROTECTIVE COPPER MESH

844  
00:46:36,500 --> 00:46:37,966  
BENEATH THE PAINTWORK,

845  
00:46:38,066 --> 00:46:41,066  
AN INNOVATION KEEPING YOU,  
THE PASSENGER, SAFE

846  
00:46:41,166 --> 00:46:45,033  
FROM A 100 MILLION VOLT  
LIGHTNING STRIKE.

847  
00:46:45,133 --> 00:46:46,366  
HADDAD: WITHOUT THIS,

848  
00:46:46,466 --> 00:46:49,366  
THE CONSEQUENCES COULD BE  
EXTREMELY DANGEROUS,

849  
00:46:49,466 --> 00:46:52,400  
BOTH FOR THE PLANE  
AND FOR PEOPLE.

850  
00:46:52,500 --> 00:46:56,533  
OF COURSE IT'S VERY SATISFACTORY  
TO SEE SOMETHING LIKE THIS,

851  
00:46:56,633 --> 00:47:00,000  
THAT THE PROTECTION  
IS WORKING AS DESIGNED

852  
00:47:00,100 --> 00:47:02,666  
AND IT'S DOING ITS JOB  
EFFECTIVELY.

853

00:47:08,033 --> 00:47:10,600

NARRATOR: WHETHER YOUR PLANE IS  
MADE OF COMPOSITE OR ALUMINUM,

854

00:47:10,700 --> 00:47:13,533

WHAT'S CERTAIN IS  
IT'S GOT TO WORK.

855

00:47:13,633 --> 00:47:17,333

IT'S GOT TO KEEP YOU SAFE,  
KEEP YOU IN THE AIR,

856

00:47:17,433 --> 00:47:22,500

AND IT'S GOT TO DO IT OVER  
AND OVER AND OVER AGAIN,

857

00:47:22,600 --> 00:47:24,966

AND THAT ISN'T EASY.

858

00:47:31,366 --> 00:47:34,500

LARGE PASSENGER JETS ARE AMONG  
THE MOST SOPHISTICATED

859

00:47:34,600 --> 00:47:38,300

AND COMPLEX MACHINES EVER BUILT.

860

00:47:38,400 --> 00:47:43,300

THIS AIRCRAFT HAS  
AN INCREDIBLE 4 MILLION PARTS.

861

00:47:43,400 --> 00:47:46,800

IF ANYTHING WERE TO GO SERIOUSLY  
WRONG WITH ANY ONE OF THEM,

862

00:47:46,900 --> 00:47:53,000

EVEN ONCE, THE RESULTS  
COULD BE CATASTROPHIC.

863

00:47:53,100 --> 00:47:56,866

IN ITS LIFETIME, IT MAY BE  
REQUIRED TO FLY 2,000 TIMES

864

00:47:56,966 --> 00:47:59,000

AROUND THE EARTH, EQUIVALENT TO

865

00:47:59,100 --> 00:48:02,700

OVER 100 JOURNEYS  
TO THE MOON AND BACK.

866  
00:48:04,833 --> 00:48:09,533  
IN THE 8 YEARS SINCE THE FIRST  
AIRBUS A380s CAME INTO SERVICE,

867  
00:48:09,633 --> 00:48:12,766  
A HUNDRED MILLION PEOPLE HAVE  
FLOWN ON THEM.

868  
00:48:12,866 --> 00:48:15,000  
REMARKABLY, IN ALL THAT TIME,

869  
00:48:15,100 --> 00:48:20,466  
NOT A SINGLE LIFE HAS BEEN LOST  
IN ONE DUE TO MALFUNCTION.

870  
00:48:20,566 --> 00:48:24,166  
THAT'S THANKS IN PART TO SOME  
AMAZING BEHIND-THE-SCENES WORK

871  
00:48:24,266 --> 00:48:27,566  
THAT MOST OF US PASSENGERS  
NEVER GET TO SEE.

872  
00:48:30,766 --> 00:48:34,000  
HERE IN DUBAI, EMIRATES  
AIRLINES' FLEET OF A380s

873  
00:48:34,100 --> 00:48:38,166  
HAS REACHED A MAJOR MILESTONE.

874  
00:48:38,266 --> 00:48:39,300  
SOME OF THESE PLANES

875  
00:48:39,400 --> 00:48:43,166  
HAVE CLOCKED UP CLOSE TO  
13 MILLION AIR MILES,

876  
00:48:43,266 --> 00:48:46,500  
AND THAT HAS TAKEN ITS TOLL,  
SO THEY'RE NOW BEING CALLED IN

877  
00:48:46,600 --> 00:48:51,033  
FOR THE ULTIMATE SAFETY CHECK:  
THE STRIP-DOWN.

878

00:48:54,366 --> 00:48:56,833  
TO INSPECT THE AIRCRAFT  
FOR WEAR AND TEAR,

879

00:48:56,933 --> 00:49:00,566  
IT'S STRIPPED BACK  
TO THE BARE BONES.

880

00:49:00,666 --> 00:49:04,133  
OVER AN 8-WEEK PERIOD,  
ENGINEERS WILL CAREFULLY REMOVE

881

00:49:04,233 --> 00:49:08,033  
1,600 KEY PARTS.

882

00:49:08,133 --> 00:49:12,900  
THEN THEY'LL PORE OVER EVERY  
INCH OF THE EMPTY SHELL.

883

00:49:14,300 --> 00:49:17,266  
ANIL VAZ IS  
THE ENGINEER IN CHARGE.

884

00:49:40,466 --> 00:49:42,333  
NARRATOR: WHEN AN AIRCRAFT  
IS IN FLIGHT,

885

00:49:42,433 --> 00:49:45,433  
THE WINGS HANDLE  
PHENOMENAL STRESSES.

886

00:49:47,300 --> 00:49:52,133  
TINY CRACKS CAN FORM IN  
THE WINGS' INTERNAL STRUCTURE.

887

00:49:52,233 --> 00:49:55,766  
IF JUST ONE WERE LEFT TO GROW  
INTO A MAJOR FLAW,

888

00:49:55,866 --> 00:49:58,833  
IT COULD BRING DOWN A PLANE.

889

00:50:36,733 --> 00:50:38,166  
NARRATOR: THE STRIP-DOWN  
IS ALL ABOUT

890

00:50:38,266 --> 00:50:42,500

SPOTTING POTENTIAL PROBLEMS  
BEFORE THEY BECOME SERIOUS.

891  
00:50:43,900 --> 00:50:45,166  
AND ONCE THEY PUT IT  
BACK TOGETHER,

892  
00:50:45,266 --> 00:50:49,066  
THIS A380 SHOULD FLY  
FOR ANOTHER 6 YEARS

893  
00:50:49,166 --> 00:50:51,866  
BEFORE ITS NEXT MAJOR OVERHAUL.

894  
00:50:53,300 --> 00:50:56,100  
THANKS IN PART TO THIS LEVEL  
OF SAFETY CHECKING,

895  
00:50:56,200 --> 00:50:59,333  
FLYING IS NOW SAFER  
THAN EVER BEFORE.

896  
00:51:16,233 --> 00:51:19,166  
NARRATOR: THE INCREDIBLE SAFETY  
RECORD OF MODERN AIRCRAFT

897  
00:51:19,266 --> 00:51:23,266  
IS LITTLE SHORT OF  
AN ENGINEERING MIRACLE.

898  
00:51:23,366 --> 00:51:26,200  
THIS ACHIEVEMENT HAS BEEN KEY TO  
THE GROWTH OF AVIATION

899  
00:51:26,300 --> 00:51:29,533  
INTO WHAT IT IS TODAY.

900  
00:51:29,633 --> 00:51:33,333  
BUT KEEPING A MILLION PASSENGERS  
CONSTANTLY IN THE AIR,

901  
00:51:33,433 --> 00:51:36,933  
ALONGSIDE A PARALLEL  
WORLD OF FLYING CARGO,

902  
00:51:37,033 --> 00:51:41,500  
IS AN ASTONISHING FEAT THAT  
MOST OF US TAKE FOR GRANTED.



903  
00:51:41,600 --> 00:51:43,033  
NONE OF THIS WOULD BE POSSIBLE

904  
00:51:43,133 --> 00:51:45,400  
WITHOUT AN INVISIBLE  
ARMY OF PEOPLE

905  
00:51:45,500 --> 00:51:48,933  
KEEPING YOU AND YOUR PLANE SAFE.

906  
00:51:49,033 --> 00:51:51,900  
AND THANKS TO  
THEIR SKILL AND CARE,

907  
00:51:52,000 --> 00:51:56,033  
YOUR FLIGHT IS ABOUT TO  
REACH ITS DESTINATION.

908  
00:51:56,133 --> 00:51:57,566  
[TIRES SCREECH]

909  
00:52:01,566 --> 00:52:01,566  
Narrator: You're 30,000  
feet up in the sky.

910  
00:52:01,566 --> 00:52:03,466  
Narrator: You're 30,000  
feet up in the sky.

911  
00:52:03,566 --> 00:52:06,200  
Narrator: You're 30,000  
feet up in the sky.

912  
00:52:06,300 --> 00:52:09,066  
Narrator: You're 30,000  
feet up in the sky.

913  
00:52:09,166 --> 00:52:10,233  
Narrator: You're 30,000  
feet up in the sky.

914  
00:52:10,333 --> 00:52:12,433  
Narrator: You're 30,000  
feet up in the sky.

915  
00:52:12,533 --> 00:52:13,633

Narrator: You're 30,000  
feet up in the sky.

916  
00:52:13,733 --> 00:52:15,566  
Narrator: You're 30,000  
feet up in the sky.

917  
00:52:15,666 --> 00:52:17,300  
Narrator: You're 30,000  
feet up in the sky.

918  
00:52:17,400 --> 00:52:18,966  
Narrator: You're 30,000  
feet up in the sky.

919  
00:52:19,066 --> 00:52:21,233  
Narrator: You're 30,000  
feet up in the sky.

920  
00:52:21,333 --> 00:52:23,300  
Narrator: You're 30,000  
feet up in the sky.

921  
00:52:23,400 --> 00:52:24,366  
Narrator: You're 30,000  
feet up in the sky.

922  
00:52:24,466 --> 00:52:26,333  
Narrator: You're 30,000  
feet up in the sky.

923  
00:52:26,433 --> 00:52:29,066  
Narrator: You're 30,000  
feet up in the sky.

924  
00:52:26,433 --> 00:52:35,566  
Narrator: You're 30,000  
feet up in the sky.

925  
00:52:35,666 --> 00:52:38,566  
Narrator: You're 30,000  
feet up in the sky.

926  
00:52:38,666 --> 00:52:40,900  
Narrator: You're 30,000  
feet up in the sky.

927  
00:52:41,000 --> 00:52:43,666

Narrator: You're 30,000  
feet up in the sky.